

Teacher education from the perspective of Teaching-Oriented Activity: a case study in a Mathematics Club¹

Formação de professores na perspectiva da Atividade Orientadora de Ensino:
uma experiência em um Clube de Matemática

Formación de profesores desde la perspectiva de la
Actividad Orientadora de la Enseñanza:
una experiencia en un Club de Matemáticas

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RESUMO

O texto tem por objetivo analisar como ações de planejamento coletivo, envolvendo conhecimentos de geometria, podem constituir-se como atividade formativa de professores. As discussões apresentadas têm por base uma pesquisa de doutorado que investigou a aprendizagem da docência de licenciandos em Matemática inseridos no espaço formativo do Clube de Matemática do Instituto Federal do Espírito Santo, com base em um movimento de estudo e organização de ações de ensino de geometria. A pesquisa em questão fundamentou-se na Teoria Histórico-Cultural, na Teoria da Atividade e na Atividade Orientadora de Ensino. À luz desses pressupostos, a formação docente configura-se como um processo de natureza social e dialógica, orientado pelas necessidades e demandas do trabalho pedagógico, integrando discussões e ações que se vinculam à atividade principal do professor, isto é, à atividade de ensino. Diante disso, as ações formativas realizadas no Clube de Matemática do Instituto Federal do Espírito Santo, durante a pesquisa de doutorado, estruturaram-se em

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quatro momentos principais: estudo teórico, planejamento das ações de ensino, interação com alunos ou professores da educação básica e avaliação. Neste texto, destaca-se, em especial, o momento de planejamento como uma continuidade do estudo teórico-metodológico. Compreende-se que o movimento formativo no Clube de Matemática se fundamenta na necessidade de os participantes se apropriarem de conhecimentos historicamente acumulados, por meio do estudo do movimento lógico-histórico dos conceitos como premissa para planejar ações de ensino. Os dados evidenciaram o planejamento como uma atividade formativa para os professores participantes, ressaltando-se a importância do trabalho coletivo e do compartilhamento de ações para a superação das dificuldades enfrentadas pelos futuros professores na organização do ensino.

Palavras-chave: Clube de Matemática; Planejamento; Formação docente.

ABSTRACT

The text aims to analyze how collective planning actions, involving knowledge of geometry, can constitute a training activity for teachers. The discussions presented are based on a doctoral study that investigated the learning of teaching among undergraduate mathematics students engaged in the formative space of the Mathematics Club at the Federal Institute of Espírito Santo, based on a process of study and organization of geometry teaching activities. The study in question was grounded in Cultural-Historical Theory, Activity Theory, and Teaching-Oriented Activity. In light of these assumptions, teacher education is understood as a social and dialogical process, guided by the needs of pedagogical work and integrating discussions and actions related to the teacher's main activity, that is, teaching. In this context, the formative actions carried out in the Mathematics Club at the Federal Institute of Espírito Santo, during the doctoral research were organized into four main stages: theoretical study, planning of teaching activities, interaction with students or teachers in basic education, and assessment. In this text, the planning phase is highlighted as a continuation of the theoretical-methodological study. It is understood that the formative process in the Mathematics Club is based on the need for participants to appropriate historically accumulated knowledge, through the study of the logical-historical development of concepts, as a premise for planning teaching activities. The data indicated that planning serves as a formative activity for participating teachers, underscoring the value of collaborative work and the sharing of practices to address the challenges future teachers encounter in organizing instruction.

Keywords: Mathematics Club; Planning; Teacher Education.

RESUMEN

El objetivo de este texto es analizar cómo las acciones de planificación colectiva, que implican conocimientos de geometría, pueden constituir una actividad formativa para los docentes. Los debates presentados se basan en una investigación de doctorado que estudió el aprendizaje de la docencia de los estudiantes de la licenciatura en matemáticas dentro del espacio formativo del Club de Matemáticas del Instituto Federal de Espírito Santo, a partir de un movimiento de estudio y organización de acciones de enseñanza de geometría. La investigación en cuestión se fundamentó en la Teoría Histórico-Cultural, la Teoría de la Actividad y la Actividad Orientadora de la Enseñanza. A la luz de estas suposiciones, la formación docente se configura como un proceso de naturaleza social y dialógica, orientado por las necesidades y demandas del trabajo pedagógico, que integra debates y acciones vinculadas a la actividad principal del profesor, es decir, a la actividad docente. Ante esto, las acciones formativas llevadas a cabo en el Club de Matemáticas del Instituto Federal de

Espírito Santo, durante la investigación de doctorado, se estructuraron en cuatro momentos principales: estudio teórico, planificación de las acciones de enseñanza, interacción con alumnos o profesores de educación básica y evaluación. En este texto, se destaca el momento de la planificación como una continuidad del estudio teórico-metodológico. Se entiende que el proceso formativo en el Club de Matemáticas se basa en la necesidad de que los participantes se apropien de los conocimientos históricamente acumulados, mediante el estudio del movimiento lógico-histórico de los conceptos como premisa para que planifiquen acciones de enseñanza. Los datos pusieron de manifiesto que la planificación es una actividad formativa para los profesores participantes, destacándose la importancia del trabajo colectivo y del intercambio de acciones para superar las dificultades a las que se enfrentan los futuros profesores en la organización de la enseñanza.

Palabras clave: Club de Matemáticas; Planificación; Formación de profesores.

1 Introduction

The trajectory of educational public policies in Brazil in the 21st century has produced important advances in access to basic and higher education, as indicated by statistical data from the historical series of the educational census. However, these same data also point to important challenges to be addressed, especially regarding students' permanence in education systems and the quality of the education offered. Such challenges raise different problematizations, with teacher education among the elements under debate.

Before these challenges, teacher education has been the object of attention and discussion by political, economic, and academic groups and collective entities, such as associations and unions. In this broad debate, since the 2000s, we have noted the approval of several curriculum guidelines for initial and continuing teacher education (DCN/2002, DCN/2015, DCN/2019, DCN/2024), as well as the creation of government programs (Mais Educação, Pibid, Residência Pedagógica, Pé de Meia – Licenciatura). These initiatives have prompted many other actions in the academic field, since higher education institutions were and are required to restructure teacher education processes.

In this context, many groups of researchers are conducting investigations to rethink teacher education beyond the technical and conceptual dimensions, choosing processes that value integral and humanist education. From this perspective, the concept of pedagogical work assumes a central role in movements that involve

formative activities. These assumptions have supported the actions of the Study and Research Group on Pedagogical Activity (Grupo de Estudos e Pesquisas sobre Atividade Pedagógica-Gepape), of the Faculty of Education of the University of São Paulo (USP), which brings together, in an articulated way, researchers from several universities and federal institutes from different Brazilian states (Moura, 2024; Rovetta; Silva, 2025).

One of Gepape's propositions for teacher education is the creation of Mathematics Clubs as a potentially formative collective space. Through such clubs, it is possible to establish shared relationships among teaching degree students, postgraduate students, researchers, teachers, and students of basic education, thereby integrating initial and continuing education in response to the demands of pedagogical work.

At the Federal Institute of Espírito Santo Vitória Campus, the Mathematics Club (CluMat/Ifes⁶) was created in 2020 and is coordinated by the Research Group on Mathematics Pedagogical Practices (Grupo de Pesquisa em Práticas Pedagógicas de Matemática - Grupem). At CluMat/Ifes, various actions that structure didactic workshops and extension courses aimed at teachers and students in basic education are organized and developed, focusing on mathematics education (Silva; Côco, 2023). In this movement of collective organization and action in educational contexts, varied formative processes are aimed. However, in this article, we take an excerpt from the actions of CluMat/Ifes to analyze how collective planning actions involving knowledge of geometry can be constituted as a teacher education activity.

For this, we structured the article by starting with a more general approach to the formative program and citing the research references, especially the excerpts used to write this work. Next, we present our theoretical framework, which organizes teacher education from the perspective of the teaching-guiding activity (TGA). In the third part, we write about the Ifes Mathematics Club, highlighting its

⁶ The Ifes/Vitória Mathematics Club is part of the extension program "Extensionist actions in education/teaching from a cultural-historical perspective" and the research developed in this formative space is part of the following research projects "Pedagogical activity in the education of teachers who teach mathematics from partnerships between higher education institutions and basic education schools in different Brazilian regions", funded by CNPq, and the project "Pedagogical activity and teacher education: actions in a mathematics club", funded by Fapes.

formative movement. The methodological assumptions are presented in the fourth part of this article. In the fifth part, we present our analyses based on discussions about teacher planning and education at CluMat/Ifes. We conclude with our final considerations, highlighting the results of the analysis conducted.

2 Teacher education from the perspective of the teaching guiding activity

The formation of the subjects begins in the uterus, when the fetus already responds to sounds and stimuli, presenting the first signs of development. However, Lev Vygotsky's cultural-historical theory states that biological and innate factors are only the primary element for human existence, because "Humanity is not born from within people themselves" (Martins, 2013, p. 131).

For Vygotsky (2010), it is through relationships and interactions with the physical and social environment, and through the experience accumulated by previous generations, that subjects become humanized and develop their cognitive capacities. Thus, the development of human thinking does not occur from the individual to the social, but from the social to the individual, especially through relationships mediated by instruments and signs (Vygotsky, 2007). From this perspective, Araújo (2009, p. 6) highlights:

The instrument is focused on an external orientation and the sign on an internal orientation. The movement between them takes place through the process of internalization – "internal reconstruction of an external operation" - which has an essentially dialogical dynamic and, according to Vygotsky, follows a path of transformations that begins with the internal reconstruction of an external activity. The interpersonal process becomes an intrapersonal process, with the relationships established between historically constituted subjects as its context, a field par excellence of mediation.

Leontiev (2010) expands this understanding by proposing that mediation necessarily occurs within the scope of activity, considered the fundamental unit that relates the subject to the objective world. The author believes that, although since our birth we have been part of a collective (society) as we establish interactions and engage in practical activities, motivated by needs and shaped by culture, we individualize ourselves. According to Leontiev (2004, p.312), at each stage of human life, there is a main activity "[...] whose development conditions the main changes in psychic processes": in childhood, the main activity is play; from school to adolescence, it is study; and, from youth, it is work.

Especially in the educational context, Moura *et al.* (2010) state that, since the teacher's responsibility in the classroom is to teach and the student's is to learn, the respective activities of these subjects are teaching and learning. According to the authors, both activities are inseparable and constitute a dialectical unit whose mediating element is the teaching guiding activity (TGA).

By constituting itself as a general way of organizing teaching, the TGA has theoretical knowledge as its main content. According to Moura *et al.* (2010), the appropriation of this knowledge enables subjects in the learning process to structure their psychic functions and develop intellectually; that is, it allows the qualitative transformation of their psyche (theoretical thinking).

Based on this perspective, TGA has as its fundamental element the intentional and conscious organization of teaching actions to promote the appropriation of social experience and psychic development. Therefore, through this intentional teaching, students have the opportunity to appropriate scientific and theoretical concepts and achieve full human development (Moura *et al.*, 2010).

We emphasize that the teaching of a given concept should be directed to lead students to human needs similar to those that historically drove its creation and development. By reproducing the essential traits of human activity that are accumulated in the object of knowledge in question, students are enabled to engage in learning. In this movement, students can appropriate the essence of the concept, which fosters the development of theoretical thinking (Moura *et al.*, 2010).

According to Cedro, Moretti, and Moraes (2019, p. 437), "[...] the structure of the TGA must contain: the historical synthesis of the concept; the problem that triggers the process of appropriation of the concept; and the synthesis of the collective solution". Through the study and appropriation of the historical synthesis of the concept, the teacher will be able to intentionally organize tasks that present the triggering problem that addresses the human needs for the emergence and development of the concept to be worked on in the classroom, to mobilize the learning activity and the possibility of students' appropriation of knowledge. We understand, therefore, that "the teacher who puts himself into teaching activity continues to appropriate theoretical knowledge" (Author, 2025, p. 44).

We understand that although the TGA proposal directs teaching actions toward student education, teachers also educate themselves in the process of educating students (Moura, 2022). This proposal is, therefore, a general way of “educating oneself and educating the other” (Moura, Araújo, & Serrão, 2018, p. 428).

It should be noted that, in addition to the movements of theoretical studies and the intentional organization of teaching, the movement of analysis of the proposed actions is characterized as formative, since it leads the teacher to reflect on teaching practice. At this moment of analysis, the teacher engages in a dialectical reflective movement between teaching and learning activities, comparing the initially determined objective with what actually occurred during the actions with students.

Therefore, through various actions, the teaching dynamics in which teachers constitute themselves as such are present: teachers educate and change themselves, and assign meaning to their activity. That is, through the teaching activity, the teacher develops. From this perspective, when discussing the teacher’s activity, Moretti and Moura (2010, p. 347) state that:

[...] It is in the teaching work, as they develop intentional actions to address the daily challenges of teaching, that teachers constitute themselves as teachers. In this process, the subject appropriates the social forms of performance of this activity in a mediated and meaningful way, operating with historically constructed signs and instruments whose meanings are social and to which personal meanings are attributed.

Lopes (2009), meeting this premise, states that “the teacher is not born a teacher. They are historically constituted; they learn without disconnecting from the world around them; they learn from the other and also learn by reflecting” (p. 55). Thus, based on the assumptions of cultural-historical theory, the author understands that the teaching constitution is related to the subject’s own process of humanization.

According to Borowsky (2020, p. 510), for the teacher to become a teacher, they “[...] appropriate the cultural-historical movements that permeated the constitution of teaching work.” Thus, teacher education spaces gain relevance because they are favorable environments for approaching the subject through this constitutive process and for their professional development.

We emphasize that, although the teacher is constituted in the very activity, the formative activity does not occur in an individualized way, since, as stated by Vygotsky (2010), the subject develops through interaction with others and the environment. Thus, teachers educate themselves as they interact with their peers (Moura, 2004).

From this perspective, a formative context grounded in the principles of the TGA is configured as an environment favorable to teacher learning. It requires a collective space in which the teacher, whether in initial or continuing education, can enhance their individual actions by appropriating elements that contribute to their work, that is, to their pedagogical practice — which materializes in the intentional and conscious organization of actions aimed at student learning.

In this formative scenario, we highlight the Mathematics Club (CluMat), a learning space that privileges collective and collaborative formative actions in which, through the TGA, they seek to promote the materialization of the dialectical unit between theory and practice. Such actions are based on the assumption that, through the teaching activity, the teacher is constituted and develops, both professionally and in their humanization.

3 The organization of the formative space at CluMat/Ifes

The Mathematics Club has become a project spanning several states in Brazil (Lopes; Cedro, 2024) and has undergone several reconfigurations since its implementation. However, something common to all the clubs is the way they conceive education through the intentional organization of pedagogical work in a collective manner.

Lopes (2009) highlights the dynamics of the Mathematics Club centered on three fundamental moments: planning, interaction with students, and assessment. The author explains that this dynamic allows teaching degree students and others involved to engage in learning through the planning, organization, and development of tasks, the sharing of knowledge during appropriation, and the evaluation of their actions. Thus, it highlights education in the broad sense, covering mathematical, general, pedagogical, and professional practice (Lopes, 2009), aiming at the teacher's main activity, which is teaching, even though they are still in initial education, in the case of participating licensees.

Gladcheff (2015) points out that teaching work guided by the principles of the teaching guiding activity involves a set of fundamental elements: the study of the development of human activity, the elaboration of a problem that triggers learning, the collective discussion of this problem and teaching actions, as well as the socialization and analysis of the experiences lived in the classroom. In line with this perspective, we understand that such elements support a continuous movement in teacher education and articulate the three moments presented by Lopes (2009). Therefore, considering these references, we organized the formative actions of CluMat/Ifes into four main moments: theoretical study; planning of teaching actions; interaction with students or teachers; and assessment.

We call the theoretical study the moments of reading, discussion, and elaboration of syntheses on a logical-historical movement of the constitution of geometry. We understand that studying the logical-historical movement of the concept offers a way to understand that mathematical knowledge draws on contributions from several peoples in its elaboration. Moreover, the articulation between the logical and historical aspects of the object of knowledge allows a movement of conceptual appropriation, since the logical reflects not only the history of the object but also the history of its knowledge (Kopnin, 1978).

At CluMat/Ifes, we approach this study with a focus on geometry, bringing a more general movement that runs through conceptual nexuses common to different geometry concepts, including form, composition, and decomposition.

The appropriation of theoretical principles is directly related to teaching work and promotes quality change in the subjects involved (Borowsky, 2020). This process also transforms the teacher educator, who is constituted as they organize the formative actions. Its theoretical study is broader, going beyond the understanding of the logical-historical movement of concepts and including the organization of the study for participants, the promotion of discussions that articulate theory and practice, and the remodeling of formative actions to meet the group's needs.

Thus, during the first author's doctoral research, four synthesis texts were written and used during the theoretical study. The writing of these texts is the result of a theoretical study by the researcher/teacher educator on a logical-historical movement in

geometry based on Childe (1971), Lima and Moisés (1998; 2002), Gerdes (2012), Almeida (2017), Marx (2017), among others.

For the planning phase, we developed an instrument to systematize elements considered essential to the TGA, calling it a “planning systematization form”⁷. These two materials, validated during the CluMat/Ifes formative process, are part of a book (Rovetta; Silva, 2025) produced within the research movement.

We highlight the continuous character of the theoretical study, which is the first moment of the organization of the formative proposal, but was also present throughout the other moments, especially the planning, which concerns the elaboration of the teaching action to be carried out later, through workshops with basic education students or with teachers in formative processes.

We planned teaching actions based on collective work conducted in subgroups, organized around the themes of research and study for each participant. These themes were: African geometry and artifacts; volume; composition and decomposition; and length. The initial theoretical studies were fundamental to all themes; however, each subgroup needed to deepen specific aspects, seeking to identify the needs that motivated the emergence of the addressed geometric concept, the internal conceptual nexuses of the concept, and to elaborate a learning-trigger problem.

The internal conceptual nexuses correspond to the elements that underlie the concept, involving its logic, historicity, abstractions, and formalizations built in the process of human thought. Unlike external nexuses, which are related to more formal and perceptible aspects, internal nexuses express the logical-historical movement of the object studied and are constitutive of theoretical thinking (Souza, 2014).

With the beginning of the systematization of the planning, it could be presented to the other participants of CluMat/Ifes to enable discussion and collective evaluation of the teaching action during the preparation process. In Chart 1, we present key steps in this process.

⁷ For the preparation of this form, we analyzed other instruments used to assist in the organization of teaching. One of these instruments was presented by Borowsky (2017), who explains that it was intended to serve as a collective record and a tool for reflection; the other was the guiding instrument for learning about triggering situations.

Chart 1 – Planning steps

Steps	Achievement
Thinking about the proposal	Beginning of the structuring of the proposal using a planning systematization form.
1st presentation at CluMat	Presentation of the first version of the planning so that the group knows the proposal and makes contributions.
Going back to planning	After the presentation, the subgroup resumes the planning systematization, incorporating the group's considerations from the previous step.
2nd presentation at CluMat	New presentation to the group after reviewing the planning. When necessary, another stage of the planning presentation is carried out in CluMat.
Planning analysis	Time to analyze and review the planning structure, as well as prepare the tasks and materials necessary to carry it out.
Task performance in CluMat	First experience of the task elaborated with CluMat participants. It is also an assessment moment, for later readjustments and improvements.
Assessment and enhancements	Carrying out adjustments in the task and in the planning, to be carried out in the next stage in workshops for the external public (students or teachers).

Source: Rovetta (2025, p. 125)

The organization of planning through the steps presented in Chart 1 shows its dynamism, subject to adaptations and new perspectives. Therefore, we understand that the subgroup's planning serves as a basis and a guide for the development of the teaching action; however, each reality/context is different and has specific material conditions; therefore, for each new workshop, it needs to be analyzed and discussed collectively.

We understand that this dynamic is formative because, in addition to contributing to the subgroup responsible for elaborating the teaching action, it promotes the resumption of the theoretical study, both of the mathematical concept and of the pedagogical issues, favoring the articulation between theory and practice. When socialized in collective spaces, actions receive contributions from colleagues, promoting advances in participants' education (Moura; Araújo; Serrão, 2018). The sharing of actions mobilizes several processes, both by dynamizing cognitive and affective components and by causing qualitative changes in teaching actions (Lopes, 2009). In addition, through the collective elaboration of teaching actions, teachers and prospective teachers understand that pedagogical activity is dynamic and complex, and that it requires continuous study.

The interaction with students or teachers is the highlight of the workshops and gives licensees the opportunity to gain a sense of school reality. It represents the synthesis of the previous moments (theoretical study and planning) and the basis for what comes later (assessment). We emphasize that the teaching activity goes through these moments, constituted in an integrated way.

In the Mathematics Club, both the teacher and the prospective teacher learn about teaching, occupying the teacher's social role. Rovetta and Silva (2025) highlight that the workshops carried out by participants represent a possibility for articulating theoretical study and educational practice, as well as providing licensees with an opportunity to approach the teaching work, thereby planning and evaluating the actions developed, establishing a theoretical-practical relationship.

Observing a proposal to evaluate it and put it into practice is an interdependent process that reveals the dynamic nature of the teaching activity. Thus, the assessment establishes the need to revisit the planning and resume the theoretical study to promote the necessary improvements. It is a collective movement, and for this to occur, the teacher educator's intention is fundamental to the elaboration of a formative proposal that accounts for this dynamic.

Thus, we conceive of assessment as a continuous process, although we can highlight two central moments of its execution:

- At the end of the workshop: carried out by the subgroup that developed the teaching action. It is objective and seeks to identify central aspects of that moment, such as time management, the number of activities, participants' engagement, possible adjustments, and the feelings and expectations of the licensees involved.
- At CluMat: held with the larger group, in the meeting after the workshop. It is a moment when the workshop organizers share their experiences and discuss the points raised from the assessment conducted after the workshop. It aims to look at the action developed from the theoretical-methodological foundations.

We agree with Moura (2021) that the assessment has a formative character and, when carried out collectively, contributes to the construction of new levels of understanding of the activity. Likewise, we understand the relevance of the other moments; however, we highlight the planning, since "the main exercise in the formative

space is carried out in the process of planning and development of the pedagogical activity” (Moura, 2022, p. 81).

Rovetta (2025) explains that carrying out the planned action in practice transforms the knowledge of in-service and prospective teachers, who, in a continuous movement, return to discuss at CluMat to evaluate what was experienced. This process, according to Munhoz and Moura (2020), as presented in the formative activity, alters the teaching activity developed, so the Mathematics Club has the potential to advance the general approach to teacher education through the elaboration and collective development of teaching activities (Moura, 2022).

4 Methodological path

Our research is of a theoretical-empirical nature, involving the apprehension of the phenomenon of mathematics teacher education within the scope of the Ifes Mathematics Club, an intentional formative space that seeks to investigate education in its entirety and proceeds by understanding the formative process in a broad dimension. Thus, we analyze this dynamic and living process in motion, delimited by the theoretical perspective adopted.

The formative process developed at CluMat/Ifes comprises a movement of theoretical study and the organization of geometry teaching actions, involving planning, the selection of materials, and the sharing of actions in the evaluation process.

This formative movement contemplates the collective development of teaching activity. In view of this, we seek to investigate the collective character of this movement, which “[...] is fundamental to understand the genesis of teaching activity as a social structure, the way in which its relations operate, as forms of appropriation of social experiences” (Perlin, 2018, p. 157).

Using the cultural-historical theory, activity theory, and a teaching-guiding activity to discuss research in teacher education entails analyzing the social structure and the contradictory processes within it. We also need to consider teaching work and its components: mathematical education, general education, pedagogical education, and professional practice education (Lopes, 2009).

For this research, we used the CluMat/Ifes formative space in 2023, involving 22 participants, including teaching degree students —licensees—, basic education

in-service teachers, and researchers. At the time, the participants were invited to participate in the research and were free to accept. We emphasize that we complied with all ethical requirements of the research, as approved by the Research Ethics Committee (CEP), and that the names of the participants are fictitious and were chosen by them.

We produced the data in the CluMat/Ifes formative actions in weekly meetings at the mathematics teaching laboratory. To reveal the phenomenon of the formative process, we used field observation, questionnaires, field diary, formative experiments, among others, which used as a data recording instrument: audio and video recordings of the meetings, records in the researcher's diary and in the participants' notebooks, materials produced in the meetings (schemes, notes, drawings), completion of the planning form, and online questionnaires.

We seek to understand the object in the process of change (Araújo & Moraes, 2017), organizing the analysis to explain the phenomenon investigated in its development (Borowsky, 2017). In this excerpt, we present scenes that aim to reveal the totality of the phenomenon of action planning, in order to engage in dialogue with the theory.

5 Discussions about teacher planning and education

During planning, the teachers needed to study the internal links of the concept. We understand that studying the logical-historical movement of a concept offers the possibility of recognizing that knowledge draws on several peoples' contributions in its elaboration. And when we look at their history, we identify elements and relationships that constitute them, their internal conceptual nexuses.

Souza (2014) explains that, while external nexuses deal with formal aspects and more perceptible elements of the concept, internal nexuses mobilize the learner more because, by grounding the concept, they "contain the logic, the history, the abstractions, the formalizations of human thinking in the process of constituting itself human through knowledge" (Souza, 2014, p. 65). In addition, the author highlights the relationship between internal nexuses and theoretical thinking, which is structured through theoretical knowledge, since "theoretical thinking contains internal nexuses, a logical-historical movement of the object studied" (Souza, 2014, p. 64).

In the questionnaire on teacher education and the Mathematics Club, Guilherme (a master's student) reported: "In planning, one point that called our attention was the discussion on conceptual links, as it is a concept that I still do not understand well, and, in organizing the workshop with Faby, she explained it to us, clarifying some doubts I had". Kiara (licensee, participant in Guilherme's work subgroup) also reported Professor Faby's contribution to her understanding of conceptual links.

We bring this discussion into the following scene, which occurred during the planning of the workshops and prompted the need to study conceptual links, as referenced by Souza (2014). This need resulted from the action of elaborating the planning using one of the instruments proposed by the researcher/teacher educator: the planning systematization form. In it, one of the parts to be filled in by the subgroup concerned the identification of the concept's internal conceptual links.

Chart 2 – Fragment of scene 4.2 "The conceptual nexuses"

Researcher/teacher educator: We can start with your presentation on the movement of studying, a little more about nexuses, and then go back to planning and moving. Did you manage to do it? Would anyone like to comment?

Kiara: So, my group and I met yesterday to discuss the nexuses and review this part of the planning. And we saw that some of the things we had marked as internal nexuses we relocated as external nexuses. And other things we took away, because they were not even a conceptual nexus. It was very difficult to think about, but Faby used an example that, for me, was much easier, which was from the wall. So: the internal connections were the things you used to make the wall, right? Like brick, concrete, and such. And then, when making this analogy, I found it easier to try to defend some things that were like internal nexuses.

Researcher/teacher educator: And what, for example, did you say, like, that some things you put as internal nexuses and then you saw that they were external nexuses and reorganized them from there? Do you remember anything you put?

Kiara: The measuring instruments, we had put as internal nexuses and switched to external ones.

Source: Rovetta (2025, p.181)

This scene highlights the importance of collective work and the student's interaction with a more experienced teacher. This type of interaction in collective work is justified by Vaccas (2012) for "providing situations in which the meaning of planning can be theoretically appropriate" (p. 45).

By resorting to the wall analogy, Kiara pointed out that she understood the difference between the external and internal nexuses, using the unit of measurement

as an example of an external nexus. She demonstrated an understanding of the external nexus as that which is part of the concept, but which is not the basis for its construction. Regarding external nexuses, Souza (2014) explains that teaching should not be restricted to them, as this can yield only partial results in the student's learning process.

We understand that the teacher, "by appropriating knowledge from the perspective of understanding the conceptual nexuses that are present in it, has the possibility of changing his performance in educational practice" (Gladcheff, 2015, p. 190). Likewise, we envision the prospective teacher who, at the time of planning the workshop, by identifying and studying the conceptual nexuses of the addressed theme, learns the concept, modifies its relationship with mathematical theoretical knowledge, and understands it as something in motion.

In addition, to organize a planning from this perspective, it is necessary to articulate theory and practice, which is part of the teacher's teaching activity, which, in turn, must generate and promote the student's activity, allowing him to appropriate the knowledge historically produced. Therefore, another important point we highlight during planning is the elaboration of the learning-trigger problem.

To proceed with this discussion, we presented a scene in which Nira (a teacher and doctoral student) presents the systematization of the planning carried out by her subgroup. The teaching action proposed discussing composition and decomposition, and the task under preparation at that time involved constructing a patchwork quilt.

Chart 3 – Fragment of scene 4.3 “The elaboration of a learning-trigger problem”

Nira: In this step, students will talk to each other, and the triggering problem will arise. We expect this to happen because they will have flaps of various shapes and sizes, and they certainly will not be able to place them so that they do not overlap or leave a space between them. And from this, interventions will be made to help them realize the need for a pattern to make the quilt. If they do not realize it, we will delimit a time for them to do it [...].

Researcher/teacher educator: Nira, please go back to that third stage. You put there that the triggering problem will arise, then, when the part of the triggering problem comes, you put it like this: “the triggering problem will arise from the moment the students try to unite the flaps and realize that they will not fit. But for them to get into this movement of trying to unite the flaps and realize they will not fit, they have to have a triggering problem (...) this would be a question, an issue that may come up in line with your history or not.

Nira: It's true.

Researcher/teacher educator: Other issues may arise in the discussion, but, to begin with, there has to be this triggering problem that you present to them.

Nira: Yes, it really is. Here, after reading, we will write down how to make a quilt, right?

Researcher/teacher educator: Yes.

Nira: Here is the need for standardization. Isn't it?

Researcher/teacher educator: In this movement of “how are we going to make the quilt?”, they will realize it. So, how are you going to articulate this so that they start to realize this need? Here comes the problem.

Source: Rovetta (2025, p.183)

The triggering problem that teacher Nira presents in her speech, as something that will emerge from the students' discussion, refers to the one that, according to the precepts of the TGA, aims to put the concepts into practice. To this end, it prioritizes movement around resolution processes and the proposal of issues that go beyond the simple, direct application of knowledge (GEPAPe, 2024). However, we understand that this problem has been previously elaborated and is already part of the situation presented. While other issues may arise throughout the resolution process, the nuclear problem is contained within the initial situation itself. When identified, it triggers the movement of its resolution, culminating in the satisfaction of the need (GEPAPe, 2024).

Thus, the teacher must know the conceptual links that students can appropriate in a teaching situation. That is, “[...] the teacher himself must know the object to be taught, its historical process and ways of developing actions to organize his main activity, which is teaching” (Silva, 2022, p. 24). Thus, we reiterate that the

study of the logical-historical movement of the concept is essential to developing its historical synthesis.

The problem that triggered the subgroup's situation was, in fact, to question how the quilt could be made, because, in seeking a solution to this issue, the need to establish a construction pattern arose. This pattern could be a mold from which the quilt pieces would be made and subsequently put together to complete it.

Solving the triggering problem refers to the historical need that gave rise to that concept. Understanding the need and how to approach it when proposing a task are important elements of the teaching activity, as the historical and logical aspects are presented in relation to the need. As Moretti (2014, p. 36) explains, "[...] the historical aspect of the concept can manifest itself in the essence of the need for its human production, articulating itself to the logical aspect in the process of analysis and synthesis that aims at the solution of this need by the subject". The issue of the need, as well as the collective movement, was evidenced by other participants when answering an evaluation questionnaire of the actions developed, as we see below:

Chart 4 – Responses to the evaluative questionnaire

Benedito: With the study of the logical-historical movement, we appropriate the concepts and, consequently, the way of approaching them in the teaching of mathematics. So, it is broader learning because specific knowledge and teaching are gathered at the same moment of study.

Helena: In the historical synthesis of the concept, the teacher can carry out the study of what human need occurred for the need for the emergence of that concept, even as we know it today, and be prepared. Subsequently, through this synthesis, think of a triggering problem to work on in the room and finally make a synthesis of the collective solution. Faced with this "script," grounded in theory, the teacher receives guidance on how to work meaningfully in the classroom.

Kiara: The importance of the community in planning. Planning a task with the TGA assumptions is very difficult, and when more than one person is collaborating, it becomes even more fluid.

Source: CluMat/Ifes data

We understand that the proposed conditions directly influence participants' thinking, as evidenced by the statements. This formative movement enables ways of thinking that are mobilized throughout the process. We draw attention to the teacher's intentionality regarding the mathematical knowledge addressed and to the

importance of systematizing discussions through collective synthesis. Therefore, we agree with Silva (2022), who argues that the moment of evaluation is fundamental in the teaching activity, as it allows the teacher to develop through intentional and collective reflection.

Thus, preparing proposals that involve triggering problems and presenting them in CluMat/Ifes for the group to solve was an important process for everyone, as the collaborative effort to solve these problems enabled participants to evaluate them and attribute new meanings to their actions.

The teaching guiding activity, by privileging the logical-historical movement of the concept, reveals its potential to approximate the human needs that gave rise to certain mathematical concepts. Thus, historical data are not restricted to the description of facts and events but also show emerging collective needs and the movements undertaken to overcome them, especially through the production of instruments mediated by work.

Thus, when considering theoretical knowledge as the central content of the teaching guiding activity, it is up to the teacher, in the process of organizing teaching, to propose situations that lead students to mobilize the need to solve problems similar to those that, historically, have been linked to the production of knowledge (GEPAPe, 2024). Under this approach, we highlight the relevance of the theoretical study, since it enables the teacher to understand the concept in its historical development and to identify the needs involved in its production.

6 Final Considerations

We seek to analyze how collective planning actions involving geometry knowledge can be constituted as a teacher education activity. For this, we need to examine formative processes from an integral, conceptual-historical, and pedagogical perspective. Thus, we defend the Mathematics Club as a formative space that enables this type of education, both in its initial scope, aimed at teaching degree students, and in its continuing education for participating teachers and researchers.

The formative movement in the Mathematics Club is based on the assumptions of cultural-historical theory, activity theory, and the teaching-guiding activity. Therefore, we highlight the need for participants to acquire historically accumulated

knowledge by studying the logical-historical movement of concepts as a theoretical basis for planning teaching actions.

The data demonstrate that the planning moment is configured as a formative activity for participants. In addition, we highlight the formative dimension of the collective work developed in the formative movement carried out at CluMat/Ifes, in particular, the moment of planning, in which the collective sharing of actions is fundamental to overcoming the difficulties faced by prospective teachers in the organization of teaching and the expansion of possibilities.

We emphasize that planning is one of the central actions of the Mathematics Club and, according to Vaccas (2012), it becomes an educational activity for the participating licensees. In the research that subsidizes this text (Rovetta, 2025), planning proved to be a continuity of the theoretical study. This happened because the participants needed to return to the study of the logical-historical movement, in addition to the study of pedagogical and methodological issues, based on the teaching guiding activity, to structure the teaching action they planned in their subgroups. The form for the systematization of planning was important for the study movement, because, to plan the workshop in the subgroup, it was necessary to systematize some important points, considering the precepts of the teaching guiding activity, including the historical synthesis of the concept, the conceptual links, and the problem that triggers learning.

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