Obutchénie
Revista de Didática e Psicologia Pedagógica

DOI: http://doi.org/10.14393/OBv4n2.a2020-57487

Mathematics teacher education activity mediated by Teaching-Orienteering Activity

Atividade de formação de professores de matemática mediada pela Atividade Orientadora de Ensino

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ABSTRACT
The purpose of this paper is to present the Teaching-Orienteering Activity, through the elements that characterize it, as a mediation of the teacher education process that teaches mathematics. For this, it was guided by a research reasoned in the Activity Theory, in which the significance the mathematics teaching activity during a teacher training process was analyzed. The fundamental assumption is that there is a relationship between the actions organized during the training activity and the process of signifying the teachers teaching activity, which makes it possible to understand how these actions are guiding this process. The training activity was triggered by a proposition for teachers to develop teaching activities, organized in small groups and guided by the theoretical and methodological principles of the Teaching-Orienteering Activity. This, by acquiring mobilizing force, became a specific activity in the perspective formulated by Leontiev, and can be characterized as a mediator in the process of signifying the teaching activity.

Keywords: Teacher education actions. Teaching-Orienteering Activity. Teacher education. Mediation. Cultural-historical theory.

RESUMO
O objetivo deste artigo é apresentar a Atividade Orientadora de Ensino, por meio dos elementos que a caracterizam, como mediação do processo de formação do professor que ensina matemática. Para isso, tomou-se por base uma pesquisa fundamentada na Teoria da Atividade, na qual foi analisada a significação da atividade de ensino de matemática durante um processo de formação de professores. O pressuposto fundamental é o de que há uma relação entre as ações organizadas durante a atividade de formação e o processo de significação da atividade de ensino dos professores, o que torna possível compreender o quanto essas ações são orientadoras de tal processo. A atividade de formação desencadeou-se por uma proposição aos professores para desenvolverem atividades de ensino, organizados em pequenos grupos e orientados pelos princípios teórico-metodológicos da Atividade Orientadora de Ensino. Esta, por adquirir força mobilizadora, tornou-se uma atividade específica na perspectiva formulada por Leontiev, podendo ser caracterizada como mediadora no processo de significação da atividade de ensino.

Palavras-chave: Ações formadoras. Atividade Orientadora de Ensino. Formação de professores. Mediação. Teoria Histórico-Cultural.

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DOI: http://doi.org/10.14393/OBv4n2.a2020-57487

1 Introduction

In this article, we have the purpose to present Teaching-Orienteering Activity, through elements which characterize it, as mediation of the mathematics teacher training program. Such process is understood as signification, interpreted by Leontiev (1983, p. 225, our translation) as "the way one gets to master the humanity experience", becoming aware of the generalized reflex of human culture that presents itself under the shape of objects, concepts, conducts, or knowledges. In this article, we highlight the teaching activity signification during a teacher education activity, depending on the actions that constitute it.

In order to achieve our purpose, we were guided by a research concluded in 2015, based on Activity Theory, which is anchored in Historical-Cultural Theory assumptions. Through this investigation, we analyzed the signification process of the mathematics teaching activity that may emerge during a continuous teacher education activity, carried out with mathematics teachers of the first years of Primary Education (Ensino Fundamental I).

The central concept that guided the research was *activity*, formulated by Leontiev (1978, p. 315, author's highlights), understood as "*processes psychologically characterized by a goal to which the process proceeds to (its object), always coinciding with the objective that stimulates the subject to perform this activity, that is, the reason*". The research is part of a teacher education project that was organized and carried out as a network research project[3]. Such project, composed of four different investigation centers, which interacted coordinated by researchers of different public universities in Brazil, was developed during four years. One of these centers, the School of Education at University of São Paulo, was characterized as the empiric field for our research about actions carried out in a math teachers continuous education activity, especially those actions which have the potential to develop the teachers'

[3] The investigation that grounds this article was part of a network research project and counted on funding by CAPES's Programa Observatório da Educação. This program, as stated by its managers, had the objective to foment studies and researches on education, aiming to provide the articulation among graduate programs, teacher education undergraduate programs and Basic Education schools.

DOI: http://doi.org/10.14393/OBv4n2.a2020-57487

theoretical thinking, possible to be revealed in the articulation between theory and practice in the constitution of the pedagogical praxis that involves them in a collective activity.

We started from the hypothesis that the signification process of the teaching activity may emerge in the continuous teacher education activity, in which the conceptual signification, taken as its referentials, may be appropriated by the teachers in the relation they have with the actions organized in the activity development. Therefore, the fundamental assumption is that there is a relation between the actions organized during the teacher education activity and the signification process of the teachers' teaching activity, which enables us to understand how orienting these actions are in such process.

Our highlight here is given by a special action developed along the activity, which was triggered by a proposition to the teachers. They should organize teaching activities divided in small groups and guided by Teaching-Orienteering Activity's theoretical-methodological principles.

The Teaching-Orienteering Activity, initially proposed by Moura (1996) and characterized by Activity Theory elements, is understood as a theoretical-methodological base "specifically directed to the reconstitution of a human activity and its essential and necessary features in teaching and learning processes" (NASCIMENTO, 2014, p. 277). The theoretical-methodological principles that conduct it make it explicit as a unit between the teaching activity (by the teacher) and the learning activity (by the student) in the pedagogical activity context. This activity, according to the author, must be organized in a way that allows the interaction among the subjects that, facing a problem situation, share the signification of necessary concepts for the problem resolution that mobilize them to solve it (MOURA, 2012). Thus, it enables that the subjects attribute signification to their actions during the appropriation of the social significances developed by the humanity experience and synthesized in the concepts.

An extremely relevant particularity that constitutes the Teaching-Orienteering Activity is the pedagogical intentionality that provides to the

DOI: http://doi.org/10.14393/OBv4n2.a2020-57487

educational environment attention to individual differences, to the particularities of the problem put into action, and to the many present knowledges, aiming at educating subjects in the social direction of human education that has the collective as reference, what, according to Moura (2012), imprints a unique responsibility to those who organize teaching.

For this article, as already mentioned, we present the actions proposed in the teacher education activity for the development of teaching activities, which was conceived as central in the teacher education process. For acquiring its own mobilizing power, it became a specific activity in the perspective formulated by Leontiev and, as already evidenced, it was guided by Teaching-Orienteering Activity's theoretical-methodological principles that, for its part, may be characterized as a mediator in the process for signification of the teaching activity.

In this teacher education context, subgroups were organized and they were supposed to elect a concept to be taught by the teachers in their educational practice. Therefore, it becomes a problem situation for the teachers who are called to collectively create a *learning trigger situation* for the planned activity. The *learning trigger situation*, for its part, requires a set of teaching actions that aims to mobilize the students, so that they put themselves in the learning situation (MOURA et al., 2010). Through this movement, the teachers clarify the way they are organizing their teaching and whether their actions are in the direction of the theoretical-methodological perspective proposed in the teacher education activity.

2 The continuous teacher education activity in the Activity Theory perspective

In the Historical-Cultural Theory, perspective that grounds this study, the premise is that the man becomes human when he appropriates the knowledge historically produced by humanity. This appropriation process, mediated by the relationships among humans through the communication, necessary for work, is considered a learning process (or educational process) (LEONTIEV, 1978), and

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that, according to Smolka (2000), it is linked to the internalization process proposed by Vigotski (2009), when establishing that the intrapsychological relations are constituted from the interpsychological relations. In the interpretation by Smolka (2000), the internalization concept must be understood as appropriation present in the marxist work, as making and using instruments, which means, in this case, not as "a matter of possession, of property, or even domain, individually attained, but it is essentially a matter of belonging to and participating in the social practices" (SMOLKA, 200, p. 37). And, as highlighted by Araujo (2009, p. 5, author's highlights), in the

> [...] "internal reconstruction of an external operation", which has an essentially dialogic dynamic and, according to Vigotski, follows a path of transformations initiated with the internal reconstruction of an external activity, the interpersonal process is transformed into an intrapersonal process, having as a context the relationships established among historically constituted subjects, a field of mediation par excellence.

Corroborating the statements by the aforementioned authors, we considered the interrelation between development and learning through school education. In this perspective, we are also based on Vigotski (2004, p. 484) when he states that "learning is not development, but, correctly organized, it leads the child's mental development, brings to life a series of processes that, outside the learning, would become entirely unviable".

In this direction, the objective of the educational process is found, in the Historical-Cultural Theory, to be socializing the knowledge historically built by humanity. Properly organized, it becomes able to propel human development in line with the historical and social movement that constitutes it. Thus, understood as a path to psychological and, mainly, human development, school education has the primordial function of "directly and intentionally producing, in each singular individual, the humanity that is historically and collectively produced by mankind" (SAVIANI, 2011, p. 13), that is, socializing the "historically produced knowledge, aiming at the maximum humanization of individuals" (MARTINS, 2007, p. 24). However, such movement is not restricted to the teacher or student action, but to the process as a whole, considering both dimensions, teaching and

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learning, a unit, as an essence of the pedagogical activity (MOURA, 2017). The teacher aiming to teach and the student aiming to learn, where the meeting point happens in the learning space, understood as that where the subjects learn, mediated by a teaching activity (CEDRO; MOURA, 2007).

Within this context, there is the purpose and the essence of the teacher's work, subject of the mediating activity that aims to provide the appropriation of the scientific knowledge by the students through actions organized to this end (MOURA; ARAUJO, 2018). It means, according to Duarte (1993), that the teacher, through his or her work, has a mediating action between the students education in everyday life, in which they appropriate, spontaneously, the language, the objects and the habits, and the students education in the non-everyday spheres of social life, allowing them the access to objectifications, such as science and art.

We understand that the mediation between teaching and learning a concept is an activity that has as its object a concept present in the problem situation chosen as *learning trigger situation*, intentionally created or identified by the teacher as the mobilizer of the students' learning activity. It is an activity that mediates the (teacher's) teaching activity and the (the student's) learning activity - the Teaching-Orienteering Activity (TOA) -, which constitutes itself as mediation between subject and object, as defended by Leontiev (1983, p. 105), when referring to mediation as activity.

Therefore, this is the teacher's work: the teaching activity that emerges by the teaching organization in the dialectical perspective of the relation between theory and practice that, for its part, is composed of actions, one of them is the study about the theoretical knowledge of the concept and its articulation with the educational practice. The latter may be developed during a continuous education process and may be understood as "a process that occurs in the continuity of the initial education and that aims at the transformation of the school reality through the articulation between teaching theory and practice" (MORETTI, 2007, p. 24). Such process is organized in a way to propitiate the signification of the teacher's teaching activity.

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However, for that to happen, we defend that education is structured as an activity under the Leontievian perspective, considering its indissociable dimensions: orientation, constituted by object, necessity, and reason; and execution, concerning actions, operations and objectives. Davidov (1988, p. 28, our translation) states that the distinction between an activity and another is essentially given by its object, which means "... that to which the act is directed to..., that is, as something that the living being relates to, as the object of its activity...". Hence the importance of having the organization of teaching as an activity and the defense of Teaching-Orienteering Activit as mediation between the teaching and learning activity. It allows us to understand that the object of a continuous teacher education activity must be the appropriation of the meaning of *teaching activity*. The concepts, actions, and operations, through which the activity happens, may be considered as their fundamental components. In this way, we may realize the importance of the actions organized and performed collaboratively during a continuous teacher education activity, because we understand that, in this movement, as activity, the signification process of the teacher's teaching activity may be triggered and the structuration of the teacher education activity (focusing on the organization and practiced actions) must have a direct relation with the teaching organization (developed by the teachers). This relation is exposed in Figure 1, as follows.

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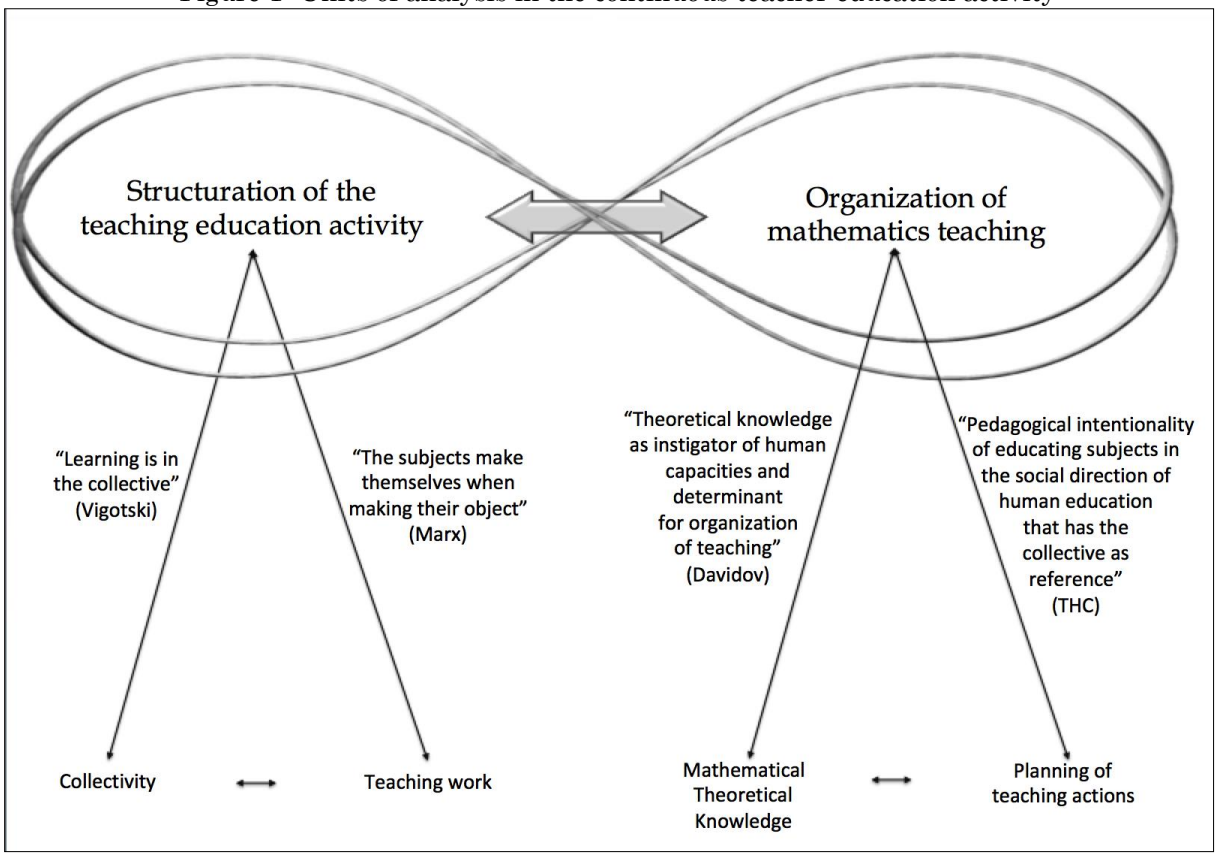
Figure 1- Units of analysis in the continuous teacher education activity



Source: Adapted from Gladcheff (2015, p. 226)

Figure 1 represents our understanding on the structuration of the teacher education activity and the teaching organization as a unit for the continuous teacher education activity. It happens because both elements, defined in our research as our units of analysis, were simultaneously analyzed, aiming to highlight the actions that have the potential for the signification process of the mathematics teaching activity to be triggered. The signification made in the direction of the meaning socially constructed for the pedagogical activity, under our perspective, is given by the understanding of school education as a path to the psychological human development.

The structuration of the teacher education activity, which has an organization based on the Activity Theory assumptions, corroborate the assumptions by Vigotski (2009) and Marx (2002) about the role of the collective work in human development.

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The productions by Davidov (1988) and Vigotski (2009) about development and learning demonstrate that the appropriation of theoretical knowledge in the direction of the subject's development is considered the essential objective in the educational process, since, as we stated before, in order to appropriate a new concept, the subjects first relate to it through social activities (interpsychological) and later turn it to themselves (intrapsychological). It is in these studies that we ground the premise that *learning is in the collective* and it is worth highlighting that, for Vigotski, according to Holzman (2002, p. 98),

> [...] human being activities, in all stages of development and organization, are social products and need to be seen as historical developments, not as mere interpersonal developments. The social is not reduced to the interpersonal; the social activity is not mere social interaction.

Marx (2002, p. 211), when identifying the work as a process in which, with his own action, the man "propels, regulates and controls the material exchange with nature", presents to us, teachers, the necessity to identify our object of work, what our action directs to and aims at the previously idealized. We understand that, in the case of school education, what is more evident as the teachers' central object is to make possible, through the teaching activity, the appropriation of concepts taken as relevant for the student's education. Not any teaching, Vigotski would say, but one that promotes development (VYGOTSKI, 1991). This Vigotski's assumption imposes us to consider that our object is the teaching activity that promotes the formation of the students' theoretical thinking (DAVIDOV, 1988). It is evident that the teacher's central activity is to have that his or her work is activity, in the leontievian meaning, an activity that structures itself as work, as being propelled to a certain end with performed actions with instruments and objective conditions of the society in which it is performed. In this way, we may have present the complexity of the teacher's activity if we assume what Leontiev (1983, p. 129, our translation) synthetically says when analyzing the formation processes of human consciousness: "*the man's activity constitutes his consciousness*". Thus, it is evident that that the teacher's object is

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one of the most complex, since it deals with the concept imprinted in the word, in the language, and already distant from its signification process.

When accepting Leontiev's premises about activity, which are born in Marx's concept of work (DAVIDOV, 1988, p. 38), we understand that the source of human development is in it, so it is also the unit of analysis of development. Thus, when analyzing the teachers' activity, we infer that it is the source for the understanding of their education, which may be understood by the analysis of what they perform as activity in order to achieve what they had idealized before in a lesson plan. It is the justification to consider teaching as a teacher continuous education activity.

Thus, as fundamental part of the mathematics teacher education activity, an action may be considered central in the education movement: developing teaching activities of math concepts, based on the perspective of a teaching that propels the psychological development and the human capacities. And, in the case of our research, we made a relation with *theoretical mathematical knowledge* and *teaching actions planning* grounded on the studies by Davidov (1988) and on the Historical-Cultural Theory assumption. We infer, by the assumptions taken here, that these actions may turn into activities. The action, when guided by the reason of organizing the teaching that promotes the student's development, starts to build a specific activity within the teacher education activity: the activity aimed at the appropriation of *theoretical knowledge as instigator of human capacities development, which has the collective as reference*.

These are considered the premises that guide the education process with its elements considered essential to be incorporated by the activity, having Leontive's perspective (1983) as reference.

3 Teaching-Orienteering Activity as mediator of the signification process

In the education movement, we highlight the role attributed to Teaching-Orienteering Activity (TOA) as mediator in the inseparable relation between the teaching and learning processes, in the pedagogical activity context.

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Initially proposed by Moura (1996, 2012), as mediation in school education, TOA is grounded on the activity theory, considering the assumptions about appropriation of Davydov's concepts (1982). It has theoretical-methodological principles structured in a way to allow subjects to interact, mediated by a content sharing meanings, aiming at collectively solving a problem situation. It is considered orienting because

> [...] it defines the essential elements of the educational action and respects the dynamics of interactions that do not always get to results expected by the teacher. It establishes the objectives, defines the actions and elects the teaching auxiliary instruments, but it does not detain all the process, precisely because it accepts that the interacting subjects share meanings that modify themselves before the discussed object of knowledge (MOURA, 2012, p. 155).

The elements that characterize TOA as mediation in the signification process of the mathematics teaching activity that may emerge during the continuous teacher education activity, when being considered orienting for the development process of the teaching activities for mathematical concepts, make us assume the centrality of TOA in the education movement. It happens because, in its formulation, such concept keeps the structure of activity proposed by Leontiev when "indicating a necessity (appropriation of the culture), a real reason (appropriation of the historically accumulated knowledge), objectives (teaching and learning), and proposes actions that consider the objective conditions of the school institution" (MOURA et al., 2010, p. 217).

Thus, TOA, "[...] that may be understood as the mediation between the teaching activity turned to the satisfaction of a teacher's 'necessity' and the activity of the student mobilized to get appropriated of humanity's social experience" (MOURA; ARAUJO, 2018, p. 212), allows the teacher, for the development, to perform and understand their object of study: the process of teaching concepts. And here we also make use of the mediation concept as interpreted by Martins (2012, p. 3), that is, as an "interposition that provokes transformations, contains socially constructed intentionality, and promotes

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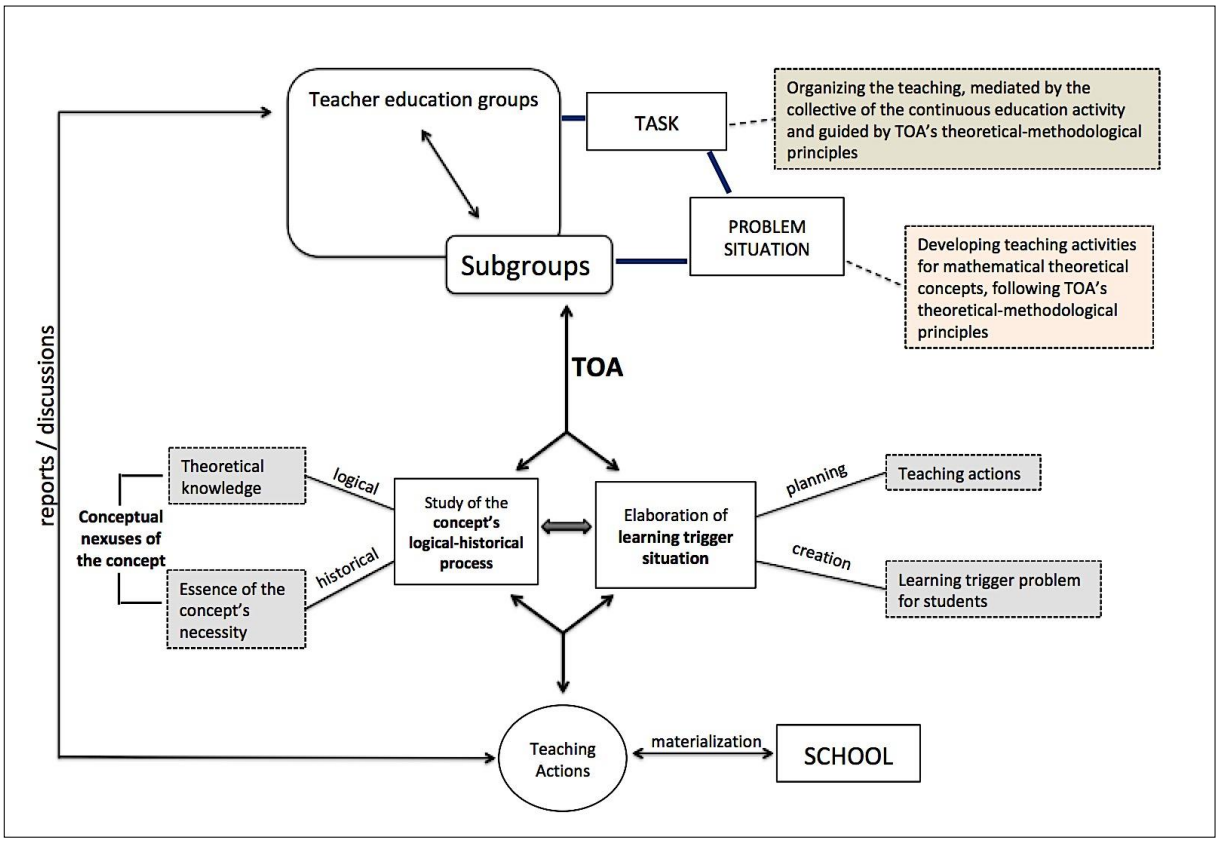
development, that is, an external condition that, internalized, potentializes the act of work, be it 'practical' or 'theoretical' ".

In the teacher education activity, TOA mediates the development of teaching activities when the execution of the task proposed to the teachers is put into practice, already mentioned: organizing teaching collaboratively and oriented by the theoretical-methodological principles of the Teaching-Orienteering Activity. This movement is represented in Figure 2.

Figure 2- Movement materialized by the task given to the teachers: organizing teaching



Source: Adapted from Gladcheff (2015, p.194)

The movement, systematized in Figure 2, represents the way how teachers were organized and guided to the solution of what became a problem situation for them, in the education movement. It brings as focus the formation of the teachers' theoretical thinking, possible to be revealed in the articulation between theory and practice in the constitution of pedagogical praxis that involves them in a collective activity.

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When highlighting the collectivity as premise for learning during a teacher education activity, we understand the necessity to ensure for teachers proposals of situations in which the sharing of actions becomes necessary for their intellectual development. Collaboration, which is part of the collective work, presupposes the development of actions based on common objectives and teachers, in this way, may transform the way they deal with the activity's object. When taking consciousness of the relations between the collective work and the object of study, the sharing of the actions may turn into a general mode of action, becoming, according to Polinova (1996, p. 151), "a kind of content model of the cognitive structure".

In order to do so, the teacher education group was divided into subgroups from four to six components, each with the task to develop teaching activities for a certain mathematical concept. In the systematization exposed in Figure 2, the principles that conduct TOA and served as mediating elements to the process are present. The challenge for teachers is, therefore, organizing teaching actions that are not restricted to

> simply reinforcing the development of empirical thinking, since it is a kind of thinking guided in the external and observable aspects of objects and phenomena, and, as such, it develops regardless of the subject's educational level. (ROSA; MORAES; CEDRO, 2010, p. 80).

With this end, teachers initiate their studies going through, themselves, the genesis or the history of the concept to be worked with their students to reveal what we understand by the conceptual nexuses (or internal nexuses) of the concept. They, for their turn, associate to the logical-historical of the studied object, representing the essential aspect of the concept and that, in this case, "are impregnated of history, that is why they are historical" (SOUSA; MOURA, 2016, p. 2). They contain "logics, history, abstractions, and formalizations of human thinking in the process of constituting as human through knowledge" (SOUSA et al., 2014, p. 96).

Kopnin (1978) highlights that the historical consists in the process of change of the object in the steps of its emergence and development, while the

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logical systematizes the medium through which the thinking performs this task in the process of reflection about the historical, in a way to reflect the main periods of such object's history. Therefore, the historical movement of the concept, made explicit in its logical-historical process, manifested in the problem situations experienced by humanity, presents the essence of the human necessities that motivated the production of such concept and that also required its logical systematization. Logics, in this case, as dialectical logics, through which "it is studied, mainly, the mental content expressed in the linguistic form, giving special attention to the relation of this content with the objective reality in the thinking process, that is, in the own process of knowledge acquisition" (DIAS; SAITO, 2009, p. 9).

Aiming at the comprehension of this movement, understood as the logical-historical process of the concept, teachers start to understand the history of mathematics as a teaching supporting instrument and establish a new relation with the knowledge, looking at science "as a living organism, impregnated of human condition, with its strengths and weaknesses" (CARAÇA, 2010, p. vii) and historically built as a product of interests and social necessities. And with this concept, as instrument in a dimension of symbolic tool, we understand its appropriation is necessary by those who integrate the school. We believe in this possibility when we consider the interface between the history of Mathematics and Education beyond a historiographic review, seeking, in the logical-historical process, the movement of thinking in the context of the formation of the studied concept.

Continuing the process, teachers, grounded on the studies about the logical-historical movement of the concept, plan, in groups, problem situations organized in *learning trigger situations* that may be materialized as: a *game* with pedagogical purpose, that preserves the character of problem; a *problematization of situations emergent from everyday life*, which allows putting the student facing the necessity to experience the solution of meaningful problems to him or her; or a *virtual history of the concept*, which puts the student in front of a problem situation similar to one lived by men (in the generic meaning) (MOURA, 2012). It

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is important to highlight, in the case of the history that involves the trigger situation, that it is not a "factual history, but one that is impregnated in concept when considering that this concept aims at a historically given human necessity" (MORETTI; MOURA, 2011, p. 443).

For the concept to be appropriated by the student, let us remember what Leontiev (1978) tells us, when emphasizing the complexity of this process. It is necessary, according to the author, to develop an activity that reproduces the essential traits of the human activity that generated the concept. Therefore, the *learning trigger situation* must

> [...] cover the concept's genesis, that is, its essence; it must clarify the necessity that took humanity to build the referred concept, how the problems and the human necessities in certain activity have emerged, and how men have elaborated the solutions or syntheses in their logical-historical movement. (MOURA et al., 2010, p.103.104)

As fundamental part of the *learning trigger situation*, teaching actions which guide students to the solution of the problem it proposes are planned, putting the concept in movement for it to be appropriated by them. What is constituted as problem in the *learning trigger situation* is considered a *learning problem*, as defined by Rubtsov (1996). And the students, when solving it, get appropriated of a general mode of action, which becomes a guiding base of the actions in different situations that surround them, and not a practical concrete problem that, for its part, seeks modes of action in itself and whose resolution only works in a specific, particular, situation.

What was collectively planned is taken by the teachers to their educational practice, as an individual action, in order to, with it, modify their students' thinking and also to learn and transform their knowledges and themselves, in a dialectic process. Next, as a continuous movement, they go back to the group to reflect about what was experienced in the school, mediated by the collective provided in the teacher education activity, bringing changes in the developed teaching activity.

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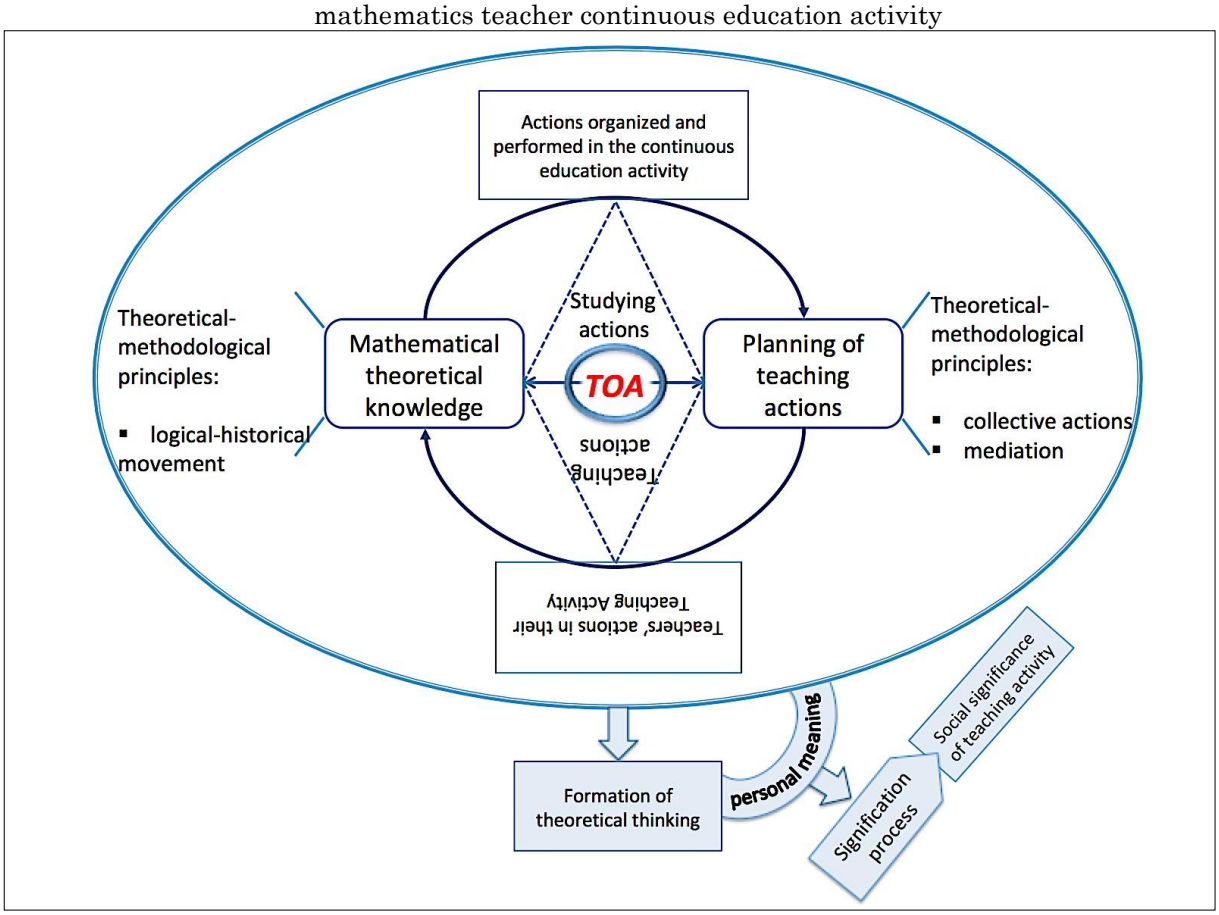
We understand that this mode of development, that allowed the teachers to get appropriated of mathematical concepts, in their theoretical form, is essential in the transformation of their actions. It makes autonomy possible for them to work the concepts through teaching activities, for the development of theoretical thinking in students, and allows teacher education not to be disconnected "from conditionings imposed by the objective reality in which they perform their work" (SOUZA; ESTEVES, 2018, p. 671). Because of that, teachers, collectively, signify their teaching activity, alternating moments of theoretical reflection and practical action in their work.

Let us focus on what Figure 3 represents, as a theoretical model of the essential relations in teaching organization in a mathematics teacher continuous education activity that aims at the development of the teacher's theoretical thinking.

Figure 3- Theoretical model of the essential relations in teaching organization in a mathematics teacher continuous education activity



Source: Gladcheff (2015, p.87)

DOI: http://doi.org/10.14393/OBv4n2.a2020-57487

With this model expressed in Figure 3, we seek to represent the movement of formation of the teacher's theoretical thinking in the teacher education activity. TOA, in this context, is activity of the teacher who, when acting in the direction of appropriating new constitutive conceptual nexuses of *mathematical theoretical knowledge* (studying actions), incorporate them in the *planning of their teaching actions*. Thus, by the same conception, the concept's logical-historical movement may be proposed as a didactic perspective for mathematics teaching (SOUSA, 2018).

Studying actions, fundamented on TOA's theoretical-methodological principles, guided by the actions organized and performed in the teacher education activity, may be constituted as modes of studying, so that collective actions are characterized as content and general mode of action for the teachers' action in their teaching activity. It means that the teachers' *teaching action* incorporate, singularly, the collective actions performed in the teacher education activity, influenced by the relation they develop with *mathematical theoretical knowledge* and *planning of their teaching actions*.

The *mathematical theoretical knowledge*, considering the concepts' logical-historical movement as apprehender of the essence of the conceptual and historical movement of the knowledge produced by humanity and the *planning of teaching actions*, as essential part in the organization of teaching and guided by the pedagogical intentionality of educating subjects in the social direction social of human education that has the collective as reference are constituted, in this way, in a relation of unit between the studying actions and the teacher's teaching actions, mediated by Teaching-Orienteering Activity's theoretical-methodological principles.

The described movement allows the development of the teachers' theoretical thinking, focusing on the personal meaning that they attribute to teaching and causes the emergence of the signification process, which we hope to converge to the social significance of the teaching activity, proposed in the teacher education activity.

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We highlight here that, in our understanding, based on studies by Leontiev (1978), the terms *signification* and *social significance* are not synonyms. We understand that *social significance*, as something more stable, is related to the function socially established to a cultural object, material or not, while *personal meaning* concerns what this cultural object means to the subject, and *signification* is in the phenomenon, it is the way of perceiving the things that constitute us and it is, therefore, interpreted by the process through which the man becomes aware of the world that surrounds him (GLADCHEFF, 2015). In Leontiev words (1983, p. 125, our translation):

> [...] If the external sensitivity relates in the subjects' consciousness the signification with reality in the objective world, the personal meaning relates them with the reality of their own lives inside this world, with their motivations. Personal meaning is also what originates the partiality of human consciousness.

Returning to what the previously described movement indicates, we may affirm that the teachers who are active, in the teacher education movement, start to attribute to their teaching activity a different meaning from what other teachers attribute. However, we understand that it is not "any" mode of organization that will sustain the attribution of meaning to actions that have potential to trigger the signification process. It is necessary that the signification converge to the social significance of the teaching activity fundamented on the historical-cultural theory and, in order to do so, we defend that the development of teaching activities need to be integrated to a teacher education process structured as *activity*, mediated by the Teaching-Orienteering Activity's theoretical-methodological fundamentals.

4. Teacher education actions in the teacher education activity

The investigation we carried out, as already mentioned, was part of a network research project that, since its initial conception, was idealized and organized according to the structure of an activity (MARCO et al., 2018). In the collaborative project development, with undergraduate and graduate students,

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and basic school teachers, there was the aim to understand the teacher education processes through the actions performed for its objectivation.

It was in this interaction movement, integrated in the center of the School of Education at University of São Paulo, that we proposed to investigate the signification process of the mathematics teaching activity of the teachers who participated in the project, aiming to identify potential actions that focus on this signification.

We put ourselves as subjects in the teacher education movement and we were part of the decisions taken by the group, in a way to think and act in the organization of the meetings, putting ourselves as active subjects. It is worth highlighting that, during the development of the teaching activities, in the movement reported in the previous section, we were part of one of the subgroups and, with other integrants, we developed *learning trigger situations* for the concept of time measurement.

Therefore, data collection was done throughout the teaching education process, developed during 4 years, totalizing 134 weekly meetings, in which the teachers' actions and reflections were registered in video. Among them, we identified the actions we consider to be educational, due to focusing on the signification process of the mathematics teaching activity of the teachers, that is, because they are relevant to understand their teaching activity.

Thus, we present the actions oriented to each of the objectives proposed to the teachers' learning, exposed in Figure 4, that must be considered as part of a whole in which they are interrelated.

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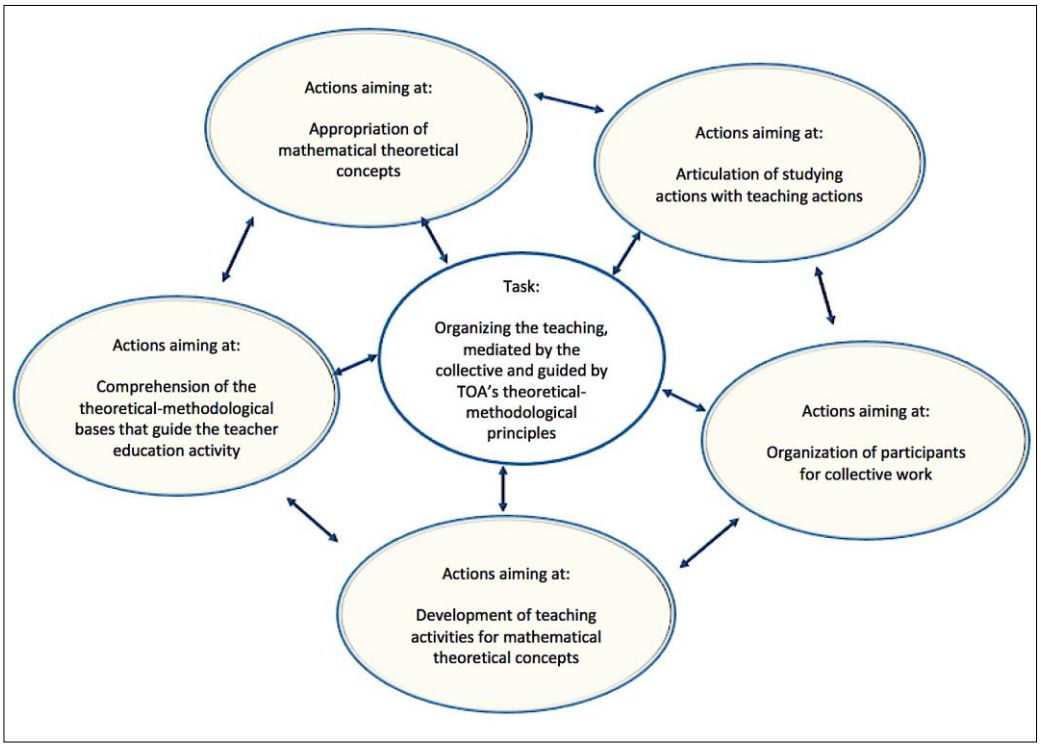
Figure 4 - Representation of the dynamism and the relation among the potentially educational actions in the continuous teacher education activity



Source: Gladcheff (2015, p. 238)

The interrelation among the actions allows us to put the teacher education movement as activity, in Leontiev's perspective, when they are understood as a dynamic unit, relating dialectically, in which the objectives continuously intercalate. Because of that, it is impossible to tightly relate them to each element that composes the essence of the theoretical thinking formation movement that, according to Davidov (1988), involves analysis, reflection and the interior plan of actions.

The actions we proposed (identified by A1 (Action 1), A2, A3, ..., A24) and that are allocated according to the five objectives described by Figure 4 are exposed in Table 1.

Table 1: List of actions proposed to the teacher education activity

Objective	Actions
Comprehension of the theoretical-methodological bases that guide the teacher education activity	A1- To read, individually, texts related to theoretical concepts concerning the Historical-Cultural Theory and the activity theory.
	A2- To participate in expositive synthesis in/by the group about the Historical-Cultural Theory and the activity theory, developed by one or more integrants of the teacher education group.
	A3- To discuss, collectively, theoretical concepts in the Historical-Cultural Theory and activity theory.

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Appropriation of mathematical theoretical concepts	A4- To read, individually, texts related to mathematical theoretical concepts.
	A5- To participate in expositive synthesis in/by the group about mathematical theoretical concepts, developed by one or more integrants of the teacher education group.
	A6- To systematize mental actions regarding mathematical theoretical concepts.
	A7- To read, individually, texts about the history of mathematics and its influence on human knowledge.
	A8- To collectively discuss about the history of the human necessity that allowed the creation of a mathematical knowledge.
	A9- To collectively discuss about the formal logic of a mathematical theoretical concept.
	A10- To collectively solve a learning trigger problem for a mathematical theoretical concept.
	A11- To participate in a pedagogical workshop, manipulating pedagogical materials.
Articulation of studying actions with teaching actions	A12- To report experiences lived in the school and in the classroom.
	A13- To read, individually, texts related to teaching actions for mathematical theoretical concepts.
	A14- To participate in expositive synthesis about texts related to teaching actions under the Historical-Cultural Theory's perspective, developed by one or more integrants of the teacher education group.
	A15- To collectively discuss texts related to teaching actions under the Historical-Cultural Theory's perspective.
	A16- To collectively discuss about the theoretical-methodological principles of the teaching-orienteering activity.
Organization of participants for the collective work	A17- To compose subgroups to perform actions that are part of the teacher education meetings.
	A18- To plan the schedule and actions for the teacher education meetings.
	A19- To systematize presentations concerning what was produced during the teacher education meetings.
	A20- To register the development of each teacher education meeting.
Development of teaching activities for mathematical concepts	A21- To elaborate, in subgroups, a problem to trigger the learning of a mathematical concept after having studied the concept's logical-historical movement.
	A22- To present to the teacher education group a learning tigger situation for a mathematical theoretical concept, elaborated in subgroups.
	A23- To develop in the school a learning trigger situation, planned during the teacher education meetings.
	A24- To report, to the teacher education group, the experience obtained with the development of a learning trigger situation in the school.

Source: Munhoz & Moura (2019, p.81-82)

With the actions from A1 to A3 directed to the understanding of the theoretical-methodological bases that guide the teacher education activity, the process integrants establish a relation between what is being proposed by the theoretical base that grounds the process and what is performed by the group. In this way, the subjects attribute significance to the actions organized and performed during the teacher education activity, understanding the collectively built social significance of the pedagogical activity, according to the theoretical perspective that guides such education.

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The actions from A4 to A11, guided to the appropriation of mathematical theoretical concepts, allow the understanding of mathematical knowledge in its theoretical form, as an ever-developing production, that comes from human necessities and reflects the laws of the world that surrounds us, working as a potent instrument for the knowledge and the domain of the nature in a dimension of symbolic tool (ALEXANDROV, 2016; MOURA, 2013). The appropriation of concepts with this perspective allows the teachers to enjoy a new tool, a new instrument to act with more confidence in their working activity (LANNER DE MOURA; SOUSA, 2002).

The actions from A12 to A16, destined to articulate the studying actions with the teaching actions, put the teachers in a process of reflection and analysis about their actions practiced in the school environment and directly connected to the studying actions in the teacher education activity. Among these actions, there is the approach and the debate about the theoretical-methodological principles that characterize the Teaching-Orienteering Activity, so that teachers understand them and become aware of their educational potential.

When participating in an educational process developed as an activity under Leontiev's perspective, teachers must be subjects of their actions and, because of that, participate in decisions made by the group. It is evidenced by the actions A17 to A20, guided to the purpose of organizing the participants for collective work, although all the other actions also have this reference. It happens because the teacher education group becomes a collective for the "people's interaction and interrelations, mediated through the objectives, tasks, and values of the common activity, that means, through their true content" (PETROVSKI, 1984, p. 37, our translation). These actions allow the teachers to become aware of the relevance of planning their actions in every moment of their teaching activity, including their own actions in the teacher education group and in their working activity, since the collective work condition puts them in a movement of creation and social relations, able to guide them in the performance of actions inside this human activity (FRANCO, 2015).

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Finally, we highlight the actions from A21 to A24, guided to the development of teaching activities for mathematical concepts, as constituents of the essential element in the continuous teacher education movement, because they have a direct relation with the main action of the teacher's teaching activity: planning and developing teaching activities that get materialized in the school. In this process, mediated by the collective provided by the teacher education activity and based on the theoretical-methodological principles that ground it, the teachers are educated while they educate their students and peers. When reporting to the group the experience lived in the school, the teachers perform a movement of reflection, analysis and assessment of their actions, remodeling them according to the necessities that emerge throughout the process.

5 Final comments

Throughout the investigation, it was possible to notice that the teachers glimpsed in the teacher education activity, through the actions that were carried out, the perspective of satisfying their necessities, what, according to Leontiev (1983), is translated in the element that starts or propels the activity. In this way, teachers understood the teacher education activity as a signification process of their teaching activity, constitutive of their professional development. The performance of the actions in the project were considered as support and mean for change in the educational practices, although, in the work environments, they faced adverse conditions to develop them.

Thus, ending this text, we highlight that the listed actions, that we may incorporate for the development of the teacher education, proposed in the investigation, attribute to the activity the possibility to trigger the signification process of the mathematics teacher's teaching activity, a signification mediated by the Teaching-Orienteering Activity's theoretical-methodological principles, that converges towards the social significance of the teaching activity, as a collective construction fundamented on the Historical-Cultural Theory assumptions.

DOI: http://doi.org/10.14393/OBv4n2.a2020-57487

In the teacher education activity, we seeked to analyze the quality of the teaching actions and, in order to do so, we observed how the teachers got mobilized and acted when organizing the teaching oriented by the proposed actions. We understand that it is through this collective movement that they start to clarify the significance they are attributing to their teaching activity and, based on it, we defend the thesis that, in a continuous teacher education activity, under the Historical-Cultural Theory's perspective, the signification of the mathematics teaching activity is developed in the subjects from the actions they perform collectively aiming at the theoretical learning of mathematical knowledges, that is, the potentially educational actions are those that develop signification on the teaching work.

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Recebido em junho de 2020.
Aprovado em agosto de 2020