

The formative didactic experiment from the perspective of developmental teaching theory*

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Abstract

This text discusses the formative didactic experiment as a modality of didactic research from the perspective of developmental teaching, according to theoretical-methodological principles formulated by Vygotsky, Davydov and Hedegaard within the historical-cultural theory. The premise is that didactic knowledge needs to be incorporated into pedagogical practices to tackle social and school inequalities, which requires research that deepens the didactic analysis of the teaching-learning process. The present study resulted from a bibliographic research of the production of the mentioned authors, with the following objectives: to describe the results of the study, highlighting the contributions of each theorist in the characterization of the formative didactic experiment and its procedures; to argue for the relevance of the formative didactic experiment approach as a microcycle of investigation. In addition, we present one of the modalities of formative didactic experiment developed in the Research Group coordinated by the authors, which integrated the principles of Vygotsky, Davydov and Hedegaard. It is concluded that the formative didactic experiment as a microcycle of investigation gives rise to didactic knowledge capable of sustaining and strengthening the developmental didactics oriented towards educational purposes in order to overcome the social and school inequalities existing in the country.

Keywords

Developmental teaching – Formative didactic experiment – Didactic research.

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Introduction

Didactics study the nature and elements of the teaching-learning process, in a system of social, scientific and cultural relations, with the view to ultimately, guide the work of teachers. When considered as applied science, the systematic study highlights the theory-practice relationship that, when interpreted by different theoretical and methodological orientations, leads to different understandings concerning the nature of didactic research. Indeed, some studies on the teaching-learning process often focus on the teacher's activity separate from the student's activity, while others investigate the student's activity leaving the teacher in the background. There are studies that, oriented by the social sciences, value more social and communicative interactions or sociocultural aspects while others emphasize more the epistemological aspects related to the scientific discipline of reference than the social, psychological or pedagogical ones. From the perspective of the developmental didactics assumed in this study, the teacher's activity and the student's activity form a dialectical and contradictory unit, around which social, cultural, psychological and pedagogical perspectives are articulated, interconnecting educational purposes, cultural practices, curriculum, teaching and learning, with a view to the psychic development of students.

Research within the scope of historical-cultural theory addresses the complex relationships between learning and development, seeking to highlight the importance of the form of organization of teaching to favor such relationships (DAVYDOV, 1988a, 1988b, 1988c; LOMPSCHER, 1999; HEDEGAARD, 1996, 2002, 2008; HEDEGAARD; CHAIKLIN, 2005; ZUCKERMAN, 2011). They formed a theoretical and methodological background of research making important contributions to didactics. On the other hand, in the Brazilian socio-educational context, there is a need for research that advances our understanding of the organization of teaching that promotes conceptual learning and student development (SFORNI, 2019), especially in public schools. It is in this sense that this article brings a conception of didactic research considered relevant to researchers interested in contributing in a radical and effective way to the production of specifically didactic knowledge and to the transformation of pedagogical practices in the emancipatory sense.

The conception and methodology of the formative experiment were developed in different groups of researchers who were constituted in the Russian context according to Vygotskian theoretical-methodological heritage. These researchers carried out atypical forms of research through formative experiments with different designs and forms of structuring. The formative experiments of a pedagogical and didactic nature were developed in particular by theorists, such as Zankov, Elkonin, Davydov, Repkin, who contributed to an accumulation of knowledge about this type of didactic research and offered different contributions to the didactic process from the perspective of teaching that promotes student development (LONGAREZI, 2019). In Brazil, during the last two decades, there has been an expansion of research characterized as didactic experiments based on historical-cultural theory, activity theory and developmental teaching theory. They have an epistemological basis in common, but, as occurred among Russian researchers, they conceived different forms of methodological design of didactic experiments thereby making relevant the knowledge of these conceptions.

Among Brazilian publications dedicated to presenting the formative didactic experiment in the conception of teaching for human development, we highlight the contributions of studies that bring this experiment as a modality of research in didactics from the contributions of Vygotsky, Zankov and Davydov (AQUINO, 2017). The analysis of the historical background of the formative experiment and the contributions of Elkonin, Davydov and Repkin (LONGAREZI, 2019) are also considered together with the development of didactic experiments in a research group, focusing on the general way of organizing teaching as mediation, teaching for the formation of concepts, (SFORNI, 2020). The contribution of this work is distinguished by producing and conceiving an integrative didactic experiment according to the ideas of Vygotsky, Davydov and Hedegaard. The objectives are: to characterize the formative didactic experiment and describe its procedures; to present, in this integrative conception, the understanding of the formative didactic experiment developed in the Historical-Cultural Theory and Pedagogical Practices Research Group. The content presented here results from bibliographic research that considered the parameters described by Lima and Miotto (2007). In the thematic parameter, it was defined by the analysis of texts by Vygotsky, Davydov and Hedegaard that address the conception of teaching for human development and, within it, the formative didactic experiment. In the linguistic parameter, texts in English, Spanish, and Portuguese were selected. In the chronological parameter, it was decided to include all texts that met the two previous parameters, regardless of publication chronology, since in these languages there is not a large amount of texts from the three authors. With these parameters, classical texts were sought according to the conception of historical-cultural and developmental teaching, as well as articles, including books, chapters and articles in journals. In the treatment of the selected material, a content record grid was used with the following focuses: conception of experiment in each of the three authors; characterization of the formative didactic experiment; conception of formative didactic experiment in the Elkonin-Davydov system; contributions to didactic research.

The text consists of two topics. In the first, the ideas of Vygotsky and Davydov are presented, followed by the contributions of Hedegaard. In the second topic, the vision of formative didactic experiment and its procedures is brought up in the research of the Historical-Cultural Theory and Pedagogical Practices Research Group, which seeks to integrate the conceptions of the mentioned theorists, understanding that it is a relevant contribution to research of a specifically didactic nature with reference to the Brazilian social and educational reality.

The formative didactic experiment in the historical-cultural conception according to Vygotsky, Davydov and Hedegaard

Vygotsky's formulation of experimental research

Investigations based on the paradigm of control of variables according to the positivist model of experiment, consist of the introduction of a stimulus that causes a response and the search for the relationship between them. In this experimental model of

investigation, reality is divided into isolated variables to be measured, and the intervening variables are neutralized. The researcher, distanced from the phenomenon, manipulates and controls the artificial situation, disregarding the real context of the phenomena investigated. This conception of experimental research was subjected to many criticisms, mainly for its inability to analyze social, psychological and educational phenomena, in addition to others. These include such issues as: the impossibility of explanatory discoveries of real, living and dynamic phenomena that do not happen in a controlled manner; the insufficiency of the model of causal relations to explain complex phenomena and that originally have multiple influences; the exclusion of inseparable aspects of society and human life, such as the way in which its history and culture relate to the production of personality and individuality; the execution of the control of actions during the experiment carried out by only one of the poles, the researcher, thereby nullifying the consideration of the subject's agency and its ability to influence the object. Such problems lead to the questioning of the extent and validity of the results (LAITINEN; SANNINO; ENGESTRÖM, 2016; ENGESTRÖM, 2011).

Vygotsky, on the occasion of his studies on theoretical and methodological issues in psychology, criticized research guided by the paradigm of control according to the positivist model of experiment, seeking a new psychology based on the cultural mediation of higher psychic functions. He concluded that the experiment based on reactive responses to stimuli (S-R), the main method of study used in psychological research at the time, was completely inadequate to investigate the question of the means and devices used by the subject to organize his conduct in concrete contexts of coping with problems. Thus, in this type of experiment, he identified limitations such as the artificial study of psychological phenomena, the observation restricted to psychophysiological responses, and results restricted to the description of quantitative variations in the S-R complex. By refusing methods based on the S-R structure, Vygotsky set himself the task of constituting a new method, according to dialectical materialism, based on the understanding that human psychic development is part of the general historical development of the human species.

The dialectical approach, admitting the influence of nature on man, states that man, in turn, acts on nature and creates, through the changes brought about in it, new natural conditions for its existence. This position represents the key element of our approach to the study and interpretation of man's superior psychological functions and serves as the basis for the new methods of experimentation and analysis we advocate. (VYGOTSKY, 2003, p. 80).

Thus, he noted the need to change the conception we have about the nature of higher psychic processes so that they could be analyzed and understood in their historical origin. By refuting the investigative method of positivist experimental practice, which did not make it possible to make visible the historical psychic processes normally hidden under the subject's usual behaviors, he argued that an effective method of studying the development of psychological processes should provide the subject with the maximum opportunity to engage in various activities that can be observed and not strictly controlled (COLE; SCRIBNER, 2017). Thus, he tried to develop another method of investigation and

called it a genetic-experimental method. For him, it was necessary to apply the principles of materialistic dialectics in order to discover what other procedures and methods did not make possible, that is, the origin and historical development of the human psychic constitution. With this understanding, he highlighted the psychological analysis of practical human activity, in which the foundations of human psychic life are rooted.

The new method would require a new analytical approach that articulated three principles: 1) procedural analysis of the main constituent elements of the history of psychological development processes; 2) revelation of the real dynamic relations that originate psychological processes; 3) dynamic analysis of the genesis of psychological processes considering the present and past unity in the development of the person. Vygotsky (2003, p. 85) understood that “past and present merge and the present is seen in the light of history”. Therefore, the basis of the investigation of human development is the search for the development of thought through a historical perspective.

The method developed by Vygotsky received the names of genetic-experimental, instrumental method, historical-genetic method, double stimulation method, and many researchers chose the terms double stimulation method and genetic-experimental method (ENGESTROM, 2011). In the author’s own texts are also found denominations such as experimental study, experimental investigation, genetic-causal method, genetic experiment, genetic investigations, or simply experiment (VIGOTSKI, 1991; VYGOTSKY, 2003, 2004, 2010). Regardless of the denomination, the experiment in Vygotsky’s conception consists in the process of identifying, understanding and explaining the historical genesis of human psychic functions under concrete conditions, revealing the movement of their emergence and transformation into social relations. The method is characterized by focusing on the activity of the individual during the active intervention of the researcher with a focus on psychic processes in training. The author considers that the researched individual is also active and not a mere object of the researcher. This conception of experiment was considered by Vygotsky as a special method to study the relationships between education, teaching and development of higher psychic processes.

The following section presents Davydov’s formulation of the formative experiment highlighting the logic of the teaching-learning process in line with the logic of dialectical reflection and the principles of the Elkonin-Davydov System.

Experimental research in Davydov’s formulation: the formative experiment

Seeking to solve one of the central problems of general psychology and development, as well as pedagogy – the links between education and human psychic development – Davydov appropriated Vygotsky’s theoretical-methodological contributions, highlighting these links even more (DAVÍDOV; MÁRKOVA, 1987). Having found that teaching based on empirical knowledge predominated in Russian schools, Davydov resorted to the studies of Rubinstein, Vygotsky, Leontiev, among others, which allowed him to conclude that in school education, a qualitatively superior knowledge should predominate: theoretical knowledge (DAVYDOV, 1982). Theoretical knowledge is formed in the study activity, which, according to Elkonin (1987), is the dominant activity in school-age children (around 6 to 10 years).

Davydov formulated his own conception of experiment as a variant of Vygotsky's genetic-modeling method, calling it a formative experiment. In the research carried out by him and his team in Russian public schools, the connection between the form of content organization, learning and the formation of logical and psychological skills by the students was emphasized, which culminated in the formulation of the form and content of the study activity. The results of these surveys were the basis for the constitution of an education system, the Elkonin-Davydov System, introduced in Russian schools in 1958. For Davydov (1988b, p. 53, our translation), the genetic-modeling method "embodies the unity between the investigation of the psychic development of children and the education and teaching of these children". In the formative experiment, the researcher intervenes in the psychic processes that he studies with a focus on the emergence of new psychic formations.

The realization of the formative experiment presupposes the planning and modeling of the content of new psychic formations that are being developed, as well as the psychological and pedagogical paths and the means to mould those new formations. In the investigation of the ways to carry out this plan (model) in the work process of cognitive learning with children, one can simultaneously study the conditions and laws of the origin or genesis of the corresponding new psychic formations. (DAVYDOV, 1988b, p. 52, our translation).

Zuckerman (2011) identifies the didactic experiment as part of a family of methods created in Soviet psychology to study the factors, conditions and means of development through education and school teaching. The author cites among her earliest and most famous antecedents: Lazurskii's natural experiment, Vygotsky's genetic-modeling experiment and Galperin's method of formation of mental actions in stages. In this family of methods, the genetic-modeling experiment occupies a place of honor and its accumulated capital made it possible, in the second half of the twentieth century, for the term developmental experiment to be used as a generic term in Russian psychology.

Situated in this family of methods, Davydov sought to empirically confirm Vygotsky's theoretical proposition about the essential role of teaching in the psychic development of students. One of its assumptions was that the bases of consciousness and theoretical thinking are formed in the process of the study activity carried out by students in school teaching. Confirmation of this hypothesis would highlight the importance of the study activity for the appropriation of knowledge in school subjects and, therefore, for the emergence of new psychic formations (DAVYDOV, 1988a). Then, he defended the idea that the programs of the disciplines should include not only the knowledge, but also the logical and psychological capacities related to this knowledge, that is, those abilities that it is expected that the students will form when performing actions in the study activity. For the formation of these capacities, it is essential that the structure of the teaching method makes it possible to guide students to understand the process of thought which moves from the abstract to the concrete, with the use of the abstract concept for the analysis of the concrete object, culminating in the formation of the integral theoretical concept of the object. In this process, the student's thought starts from the analysis of objects inserted in real social relations, first seeking to discover their laws and general abstract concepts to then use them in the analysis and interpretation of the object in singular and specific

situations, so as to attain an understanding of it in that given concrete situation. With this method of thought and action, the student works with the object in the study activity to form an understanding of a dialectical theoretical nature. Consequently, in order to carry out this method of thinking, the form of organization of teaching needs to insert students in investigative tasks and material and/or mental transformation of the object of study (HEDEGAARD, 2002b, 2008).

The formative didactic experiment reflects the conception of developmental teaching and, consequently, its logic of organization and structuring of the students' study activity. Thus, it is important to make some considerations about this logic. The main objective of teaching is for the student to form the theoretical thought mediated by science, and this thought is presented to him as generalized and abstract content, that is, in the form of a concept. Theoretical thinking is constituted by mental actions of abstraction, generalization and formation of concepts, which enable students to reconstruct the investigative processes used by researchers to obtain scientific conclusions. Thus, in the activity planned by the teacher, for students to establish a relationship of knowledge with the object, it is necessary that they reconstitute in a creative way the mental actions that allow the elaboration of the concept of the object. This procedure is characterized by a movement that starts from the collective to the individual activity, from the general aspects of the object to the particular ones, through the ascension of thought from the abstract to the concrete (DAVÍDOV, 1988; DAVYDOV, 1982, 1988b, 1996).

In order to ensure the organization of teaching, Davydov formulated the general structure of the study activity to be undertaken by the students, which consists of the following actions:

- 1st Transformation of the conditions of the study task to observe the universal relationship of the object of study;
- 2nd Modelling of this universal relationship in objective, graphic or lettered form;
- 3rd. Transformation of the universal relationship model to study its properties in 'pure form';
- 4th. Solution of a system of particular tasks that can be resolved by the general method;
- 5th. Analysis of the performance of previous actions;
- 6th Evaluation of the level of assimilation of the general method that results from the solution of the given study task. (DAVYDOV, 1988b, p. 29-30).

In the first action, students need to discover the universality of the object expressed in its general, universal and abstract relationship. A problem is presented for students to investigate and come up with the solution. First, they need to appropriate the general, universal and abstract relationship. As it is presented in the exhibition of the results of the scientific investigation that originated the object, students will not create it but discover it and recreate it for themselves, through search and investigation. Next, they need to identify the link between this relationship and other, specific ones. In the process of abstraction mediated by tasks proposed by the teacher, students apprehend and internalize the general mode of investigation of the object developed in a certain scientific area. Thus, they are appropriating these general ways and acting with them with autonomy of thought and in a creative way (DAVYDOV, 1982, 1988b).

In the second action, students construct a model that represents the general and universal relationship of the object studied. In the third, with reference to the model, the objective is to identify the movement and transitions that occur between the universal and abstract relationship and the particular and concrete relationships of the object, situating it in a given real life context. When this occurs, the conditions and means are created for students to form the theoretical concept and use it as a procedure for analysis, reflection and understanding of the object (DAVYDOV, 1988a, 1988b; HEDEGAARD, 2007, 2008).

The fourth action consists specifically in using the concept as an object analysis tool in diverse concrete situations. From now on, the teacher gradually modifies his performance in order to ensure students grow in autonomy to achieve the study goal, in the learning of and formation of the concept. The fifth and sixth actions correspond, respectively, to the analysis and awareness of the student about his learning and about the transformations in his understanding of the object. The student needs to establish the relationship between the acquisition and use of the general method of thought and action with the object and the obtaining of the solution of the problem initially proposed in the study activity (DAVYDOV, 1982, 1988b, 1999).

The didactic experiment in the Elkonin-Davydov system: macrocycles and microcycles

The structure and content of the study activity were used by Davydov in the design of the formative didactic experiment in research carried out in experimental schools from the creation of the Elkonin-Davydov educational system. This system initially resulted from the collaboration between these theorists in research on the formation and development of intellectual actions by students. Davydov (1996) reports that he became aware of Elkonin's scientific conceptions in 1958, when he ran a research laboratory at the Moscow Institute of General and Pedagogical Psychology. Between the years 1959-1960, Elkonin, Davydov and other collaborators, initiated investigations in some Moscow schools in order to substantially change the psychological and pedagogical methods of investigation, moving from verification experiments to the method of formative experiment. With reference to Moscow School No. 91, experiments were started based on new teaching programs in various cities in Russia. In 1961, Davydov was appointed head of the Laboratory of the Moscow Institute of General and Pedagogical Psychology on the occasion of Elkonin's transfer to a laboratory of adolescent psychology. In 1963, the Minister of Education of the Soviet Union officialized the transformation of school No. 91 into an experimental institution of the Academy of Pedagogical Sciences. Since the academic year 1963/64 it has been called the Moscow Experimental School No. 91 of the Russian Academy of Education (DAVYDOV, 1996; LIBÂNEO; FREITAS, 2015).

In the context of the Elkonin-Davydov system, the formative didactic experiment consists of the study of the transformation processes that provide new psychic formations and the necessary conditions for their emergence. Through school programs and experimental teaching plans, the researcher makes conjectures about the development that students can attain in relation to new levels of skills necessary to learn a subject of study. Since the beginning of the research, the authors defined that the experiments should be longitudinal, carried out in experimental institutions and in a prolonged way, with the same group

of students, lasting three to four years, with the accompaniment of collaborators from various scientific areas (psychologists, logicians, educators, physiologists, etc.). Davydov and his team understood that the longitudinal experiment allowed a better definition of the role of the various teaching factors that act in the development of students, for example, the different concepts and their sequence in a discipline, the different aspects of the study activity, etc., enabling a detailed analysis of the conditions that give rise to psychological neoformations. They understood that the monitoring of activities in the same group of students over several years would make it possible to go beyond individual psychological characteristics to analyze integral characteristics of psychic development and transitions from one behavior structure to another (DAVYDOV; MÁRKOVA, 1987).

The formative experiments in longitudinal studies of macrocycles aim to test hypotheses about specific potentialities of students according to age, and that have not been required of them by the dominant educational system in society (ZUCKERMAN, 2011, p. 53, our translation). However, longitudinal studies do not allow more specific research, and so requires recourse to microcycles “that allow the experimenter himself to exercise continuous control step by step” (ZUCKERMAN, 2011, p. 53, our translation). Unlike the experimental macrocycle, the microcycle, whose period of time can be weeks and even days, is intended to verify hypotheses about the potentialities of the development of certain psychic functions, which can occur at a specific age, within a single psychic formation (ZUCKERMAN, 2011).

A microcycle project for a formative didactic experiment requires defining and forming a theoretical concept and involves three stages: 1) determination of phases and levels of quality desired for the student’s action, that is, what should be the difference between his action at the beginning and at the end of the appropriation of a specific concept; 2) search for ways to determine at what point a student or class is, and the criteria to identify whether the changes that would be expected to occur have occurred in his action; 3) definition of the forms of pedagogical support at a certain level in the development of the student or class and the forms of pedagogical action that lead to the emergence of changes in the psychic functions of the students. The microcycle didactic training experiment also requires determining the period of development of students in relation to their main activity. From there, the teaching planning is carried out, organizing the study activity for the formation of a theoretical concept, with objectives to be achieved by the students, the respective actions and conditions to bring this about, and the didactic material. If necessary, didactic materials should be developed that are consistent with the concept of developmental teaching (ZUCKERMAN, 2011). Having outlined the formulations of Vygotsky and Davydov, the contribution of Mariane Hedegaard is now presented below.

Hedegaard’s contribution to the formative didactic experiment

]Mariane Hedegaard, investigates the formation of theoretical thinking by adding to Davydov’s ideas the analysis of the relationships between learning, institutional practices, culture, and the historical-cultural conditions of students’ lives (HEDEGAARD, 2020). It

embodies Davydov's understanding that the development of theoretical thinking is the foundation of school education. But it emphasizes that, in modern industrialized society, social relations and interactions occur within human activities that are carried out in institutional practices (family, early childhood education, school, community, etc.). In the context of institutional practices there are different human activities, with different traditions and types of knowledge, sociocultural relations and daily experiences. As a result, human activities provide concrete experiences that demand different motives and challenges to the thinking and capacity of individuals. It is necessary to consider the participation of students in these institutional practices, as human development occurs in these contexts. For Hedegaard (2020), the relationship between learning and development is influenced by social, institutional and individual perspectives, which makes it important to understand how a teacher articulates theoretical knowledge with the concrete experiences experienced by students in institutional practices. A student simultaneously participates in several institutional contexts in which there are different practices, appropriating ways of thinking there. As an institutional context, school is the place where students appropriate theoretical models that serve as tools for analyzing existing problems in institutional practices in general (HEDEGAARD, 2008, 2020; FLEER; HEDEGAARD, 2010).

Hedegaard added ideas on the dialectical articulation between the forms of development of thought and the perspectives of the student, the family, the school, society to the thought of Vygotsky and Davydov. She adds the methodology of the double movement in teaching to Davydov's actions of teaching organization. This methodology consists of planning didactic situations in order to promote the interrelationship between scientific knowledge and everyday knowledge mediated by institutional sociocultural practices. In the study tasks, this is accomplished by the insertion of elements of the students' local knowledge in the conceptual relations of the studied content, so that they acquire the theoretical knowledge and use it in their everyday life practices (HEDEGAARD; CHAIKLIN, 2005; LIBÂNEO; FREITAS, 2019). This is one of the most central ideas in the approach developed by Hedegaard and Chaiklin under the name of radical-local teaching. This idea states that the social function of the school is evident to the extent that children and young people, having recognized their social, cultural and material conditions of life, can internalize other motives and capacities for life in society in a participatory and critical way. Thus, in the didactic experiment developed by Hedegaard (2007, 2008), the movements of the students' psychic processes are observed and monitored according to the classic procedures indicated by Davydov, at the same time that a radically contextualized pedagogical intervention occurs. Through contextualized pedagogical intervention, the didactic experiment developed by Hedegaard (2007, 2008) makes it possible to observe and monitor the psychic processes of students who are in development and who, in the collective work with the object of the study activity, can be favored. Thus, a specifically didactic research is characterized.

According to Hedegaard (2008), the formative didactic experiment takes place with a close connection between scientific research and teaching, but the subjects involved are in different human activities. The researcher is in investigative activity, the teacher

is a research collaborator and is in teaching activity, while the students are in study activity. These different activities also have different objects, motives and objectives. The dominant reason for carrying out the researcher's actions is the search for answers to their research question. The dominant reason in the teacher's actions is to promote and mediate the students' study activity so that they form a concept. The dominant reason in the students' actions should be the formation of a general principle of analysis and solution of the problem presented in the task, thus forming the concept.

From this perspective, we note that there are fundamental relationships between the collective/cooperative activity of students and creation of reasons for solving problems related to content need to be ensured in the formative didactic experiment; the use of models of the conceptual relationships of the object studied and formulation of models by the students themselves to connect theoretical concepts to specific situations; methods of investigation of science, teaching methods, students' thinking strategies and changes in conceptual models and finally, the use of conceptual models by students and development of reasons for learning (HEDEGAARD, 2007, 2008; HEDEGAARD; FLEER, 2008).

So far, the didactic-formative experiment and its procedures have been characterized according to the formulations of Vygotsky, Davydov (including the principles of the Elkonin-Davydov System) and Hedegaard. The theoretical and methodological bases of an articulating conception of the assumptions of these theorists as the basis for the formative didactic experiment are explained below.

The formative didactic experiment: an integrative understanding of the assumptions of Vygotsky, Davydov, Hedegaard

The realization of formative didactic experiments has had an expressive presence in research in specific didactics and didactics in Brazil, causing new possibilities for the organization of teaching in the various school disciplines. This topic presents the activities that have been developed, since 2003, in the Historical-Cultural Theory and Pedagogical Practices Research Group, of the Graduate Program in Education of the Pontifical Catholic University of Goiás, aiming to describe and highlight the conception of the formative didactic experiment in this Group, which assumes as theoretical and methodological bases the historical-cultural theory, the theory of developmental teaching and the radical-local approach. It is considered relevant to present here this experience that, concomitantly with others that take place in the country, indicates a form of research in didactics focusing on the relationship between teaching-learning and the human development of students. There are a few reasons why this is relevant. One of them is the occurrence, in the field of pedagogical research, of certain doubts about the specificity of didactic research, based either on psychology or on sociology. The formative didactic experiment, as described in the previous sections of this article, makes it possible to investigate the teaching activity as connected to the student activity, articulating and integrating epistemological, sociocultural, psychological and didactic aspects.

Another reason is the opportunity to explain the historical-cultural conception of research in didactics. There are now many researchers in Brazil who share the historical-

cultural theoretical foundation and developmental teaching theories about the relationship between teaching, learning and human development, generating several understandings about this type of research. In the case of the Historical-Cultural Theory and Pedagogical Practices Research Group, there is the explicit purpose of seeking integration between academic research and the teaching practice of teachers through empirical research, generating knowledge to feed the theoretical investigative field of didactics and specific didactics. As presented in this text, the research through microcycles of formative didactic experiment in the context of the class produces analyzes that contribute to the constitution of developmental didactics that ensures a unity between basic didactics and specific didactics, enabling the advancement of knowledge in this area. It is also considered that the didactic experiment articulating principles of Vygotsky, Davydov and Hedegaard in concrete conditions of school education in the Brazilian reality, including living conditions of students and teachers' work, can contribute to researchers in the area of didactics finding something useful to their own research.

From the beginning, it was clear in the aforementioned Research Group that it was not a question of directly replicating the didactic experiment models carried out in the Elkonin-Davydov System in Russian schools. Davydov (1988c) clearly expressed that the validation of the results of formative experiments would require a research macrocycle of at least four years. In fact, the research with its team of collaborators in experimental schools and within the Elkonin-Davydov System, inserted in the structure of the Russian Ministry of Education, aimed to formulate content programs, teaching methods in specific areas of content, materials with methodological guidance for teachers and teaching materials. Our research is carried out in the academic sphere, and it is not possible to replicate research on macrocycles with the same purposes as those carried out by Davydov and his collaborators. What is sought are didactic experiments in microcycles, assuming the theoretical-methodological and practical challenge of using the research principles and procedures initiated by Vygotsky, developed by Davydov and added to by the contributions of Hedegaard.

One of the Group's options has been to guide the experiment towards the realization of the teaching-learning process in a real environment of common schools, within the school schedule and the teacher's work routine, aiming to obtain qualitative empirical data that allow the identification and analysis of changes in the students' psychic formations, which can be considered as an expression of concept formation or as an indication that this process is occurring, creating possibilities for development according to the students' real conditions. Therefore, we seek to analyze the relationships between psychic processes in formation, in an articulated way to the students' capacities and in connection with the form of organization of teaching. From this perspective, it is particularly relevant to analyze the ways in which students' sociocultural and institutional practices and concrete social conditions of life influence their knowledge, their types of thinking and their motives for learning, as Hedegaard and Chaiklin conceived in their writings (HEDEGAARD, 2002a; HEDEGAARD; CHAIKLIN, 2005; HEDEGAARD; FLEER, 2008). With this understanding, the researchers in the Group are strongly influenced by the ideas of the highlighted authors, including their concepts such as: human activity; cultural and historical mediation of the constitution of human consciousness; periodization of human

development; proximal development zone; the relationship between the organization of teaching and the type of thought promoted by students; the process of formation of concepts; theoretical thinking/theoretical concept as the focus of teaching and study activity; students' motives as historical subjects; relations between the social and cultural practices of students in the institutions in which they participate within local contexts of life and the forms and methods of thought that they appropriate; study activity; double teaching movement; didactic mediation.

The design of a formative didactic experiment, in addition to the conventional elements of a scientific research project, requires the prior and detailed elaboration of the teaching plan within a discipline, focusing on the study activity of an object to form its theoretical concept in a certain area of knowledge. In the project, it is necessary to establish the general and particular conceptual relationships to be formed by the students, the projection of qualitative changes in their learning and thinking, which are expected to occur under the influence of the proposed developmental teaching. It is also necessary to establish: the contents and psychic and practical actions that students are expected to perform; the teacher's actions (the collaborator in the execution of the teaching plan with the mediation of the researcher); the teaching materials necessary and consistent with the formation of the theoretical thinking of the students; the specific actions of the researcher (LIBÂNEO, 2015; FREITAS, 2016).

The teaching plan, prepared in a collaborative way with the teacher of the discipline, begins with the analysis of the content of the concept that will be the object of the students' study activity. In this analysis, through logical and historical examination, we seek to identify the general, universal and abstract relationship, expressive of the initial abstraction of the concept within an area of knowledge. The clear determination of this relationship is a condition for formulating the content of each element of the study activity (what the student will perform in each action, for what, and under what circumstances). The analysis of the content of the concept presupposes epistemological knowledge including the related investigative procedures. The elaborated study tasks need to incentivize the students' and their motivation, considering their experience in the local context of their life and linking themselves to the dominant activity in the period of human development in which they are (ELKONIN, 1987, 2012). In turn, the sociocultural and institutional practices in which students participate should be the references to promote the articulation between everyday concepts and scientific concepts, thereby making the double teaching movement real. (HEDEGAARD; CHAIKLIN, 2005, HEDEGAARD, 2002b, 2008; FREITAS; LIBÂNEO, 2019).

The didactic training experiment project also includes the training of the collaborating teacher, covering basic knowledge about developmental teaching, research purposes and procedures, constituting a link between research and professional teacher training in the real work situation.

The students' study activity is organized according to the six actions established by Davydov (1988b), and should be detailed, articulated with the objectives, considering the knowledge (daily or scientific) that students already have about the object of study. The elaboration of the actions of the study task initially considers the student facing a problem formulated to mobilize the activity with the object of knowledge, which will

unfold in the course of the six study actions through the movement of abstract to concrete thinking. During the experiment, the researcher follows the development of the students' actions *pari passu*, observing and recording them, discussing and evaluating with the collaborating teacher the successes and failures, in order to proceed with readjustments.

Regarding the methodological conditions that ensure the validity and reliability of the formative didactic experiment, Hedegaard (2008) highlights the following. Firstly, the concepts within the investigative tradition of the matter need to be formulated as conceptual relationships that, in turn, must be represented in the form of models. Secondly, the models must portray the conceptual relationships in such a way that the change in one of their aspects is reflected in the other aspects. Finally, regarding the record of interactions in the social learning situation in the field of research, there are perspectives that need to be outlined and specified. These include that of the researcher, that of the students and the collaborating teacher. Institutional practices also need to be considered as specific conditions for the social learning situation of students and the promotion of motives and skills.

Promoting the double movement in teaching requires considering the societal perspective in which cultural traditions and values are present, the institutional practices in the family and in schools and the local contexts of students' experience (HEDEGAARD, 2002a; HEDEGAARD; CHAIKLIN, 2005). Hedegaard (2008) emphasizes the dialectical and interactive character that the research must have, where the researcher is in a partnership with the teacher and student, a partnership that establishes a balanced integration of his interaction with the collaborating teacher and the students, ensuring the obtaining of significant knowledge about the researched object. The clear distinction between the students' activity (study), the researcher's activity (research) and that of the collaborating teacher (teaching) preserves their respective focuses so that their individual objectives and actions are not confused. The dominant motive of the researcher should be the research project in its entirety, while the dominant motive of the collaborating professor and students should be the learning and formation of the theoretical concept of the object.

For data collection, several instruments and procedures can be used (observations, interviews, focus groups, production of materials by students, written or in other forms, etc.) The data record can be written, audio, video (HEDEGAARD, 2007) or all simultaneously. The analysis and interpretation of the data, with reference to the changes expected and specified in the planning, focuses on indications of qualitative changes in learning, formation of objectives and use of investigative strategies by students, and the construction of models of conceptual relations of the object of study. It is important to analyze the participation of students in collective activities, the reflection on their own actions in relation to their learning, how they perceive and evaluate themselves in relation to the objectives of the task, etc. In addition to the categories specifically linked to the basic concepts of the theories of Vygotsky, Davydov and Hedegaard, the results of the analysis can be formulated into categories created from the focus on the relationships between teacher actions and students' actions. These involve social interaction, participation, motives, interests, cooperation, the development of the thought processes (problem formulation, formulation and use of models, use of procedures, changes in the model versus changes in capacities, relations and connections between the elements of the model to explain

changes identified in the object, etc.) (HEDEGAARD, 2007; HEDEGAARD; FLEER, 2008). It is essential to analyze the creative and transforming aspect of the student's relationship with the object of knowledge.

Final considerations

This study, based on the thoughts of Vygotsky, Davydov and Hedegaard, aimed to characterize the formative didactic experiment and describe its procedures as a modality of didactic research. It also aimed to present the modality of formative didactic experiment developed in our own Historical-Cultural Theory and Pedagogical Practices Research Group.

The formative didactic experiment based on the ideas of Vygotsky, Davydov and Hedegaard emerges as a relevant alternative for scientific research in the field of didactics and specific didactics. In relation to other theoretical and methodological orientations that support research in didactics, but differently from them, this concept of formative didactic experiment allows us to more explicitly understand and contemplate the relationships between sociocultural processes, changes in higher psychic functions and their relationship with concrete contexts in life and the teaching-learning process. It makes it possible to boost knowledge that contributes to broaden the understanding of the didactic process, the unity between teaching and learning, planning, organization and the effectiveness of teaching which in turn promotes human development. When considering all the epistemological, psychological and sociocultural elements involved in the teaching-learning process, it affects the strengthening of developmental didactics and, ultimately, the production of knowledge that guides school education according to this perspective.

However, it is necessary to consider that, in the Brazilian context, the concrete historical and cultural factors are very different from the context in which the theoretical-methodological bases for conducting formative didactic experiments in the Elkonin-Davydov system (Russia) and in the research contexts of Hedegaard (Denmark), were constituted. The concrete historical conditions of Brazilian public school education require imagination, political and pedagogical action, as well as research to prepare the path for developmental teaching in our schools. Meanwhile, formative didactic experiments such as microcycle research can result in knowledge that supports and strengthens developmental didactics.

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