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SECTION: ARTICLES

The development of theoretical thinking in professional education: in search of the dialectical sublation of practice[1]

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Abstract

The conditions of a culture of labour permeated by technical and technological advances tend to be seized by technical training institutions as a way to legitimize the denial, to the worker, of historically produced theoretical knowledge. Aiming at contributing to overcoming this reality, the objective of the research reported in this article was to investigate the development of theoretical thinking of students of a private school of technological and vocational education, during the elaboration of technical projects. In accordance to the cultural-historical theory, it is understood that the overcoming of learning based only on the representations and classifications of the objects allows the appropriation of scientific knowledge essential to the development of students' theoretical thinking. As methodological procedure, training experiment was adopted and data collection sought to follow the movement of learning of the students through audio records and access to their written productions at different moments of the project elaboration process. The analysis of the data took place through three isolates: reality, contradiction and consciousness. The conclusions reveal that the organization of project teaching and the orientation provided by the teacher in a professional technical course may lead to theoretical thinking with a view to an integral formation of the subject that takes labour as an ontological principle in the organization of teaching by enabling the student to have contact with reality and opportunities to reflect on contradictions, as well as to become aware of the object of study in the midst of the practical and theoretical solutions to the problem.

Keywords

Cultural-historical theory – Learning – Theoretical thinking – Technical education – Labour.

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Introduction

In the mid-twentieth century, with the advent of the third industrial revolution, computers and communication networks transformed the industry, the working method of professionals and, consequently, learning in vocational schools. Since then, the technological advancement of machines and instruments used in the production and execution of specialized services have facilitated and streamlined the actions and practical operations on workers' day-to-day activities, being constantly improved.

In Brazil, the search for adapting job learning to new demands of the market leads technical schools of the private sector to adapt their educational guidelines to competency-based teaching instead of content-based teaching (SENAI, 2009). These changes seem to reinforce the fragmentation of knowledge in the technological area with teaching focused exclusively on know-how. However, this proposal is limited because, contrary to what it claims, the technological advance proposes the solution of more complex issues in the technical field, which emerge in the context of labour that demands the student-worker's appropriation of the necessary theoretical knowledge to the external and internal analysis of phenomena (DAVIDOV, 1988) to be created and explored.

Thus, before such contradictions, the objective of the research reported in this article was to investigate the development of theoretical thinking of students of a private school of technological and vocational education, during the elaboration of technical projects (ARRUDA, 2016). Intentionally, the student was analyzed during the teaching and learning process of the last class of the refrigeration and air conditioning field, whose teaching guidelines were still content-based. In this context, the teacher had partial autonomy to choose and elaborate the content to be planned, both theoretical references and specific knowledge as well as the teaching strategies that he understood as appropriate for the learning activities in the classroom.

In this article, the contradictions of the pedagogical guidelines of the private sector are presented and, in contrast, the theoretical fundamentals of the developed research that are understood to be convergent with a humanizing proposal of teaching. Next are discussed the forms of organization of technical education anchored in such theoretical presuppositions, the formative experiment adopted as methodological procedure of data collection and, lastly, some of the conclusions resulting from the analysis of the movement of learning of the students.

Pedagogical guidelines of private technical education: changes and contradictions

In the middle of 2009, the new guidelines of the National Industry Council (CNI) emerged in order to guide the implementation of a competency-based methodology in private technical vocational education. The implementation seems to refer to the pedagogy of *know-how* supported, mainly, by the particular interests of the economy and the business community, to the detriment of a more general training for workers. In this way, such changes appear to be criticized, since "education reforms have imposed a culture of result and market principles, with an ideology exogenous to teaching, standardization of

academic and technical skills and importance to the capacity to obtain results in tests" (ITANI et al., 2015, p. 28).

If, on the one hand, the professional education system has always prioritized an empirical learning[4] of systematic operations and actions and immediate practices that spontaneously trigger quick solutions and conceal historically produced knowledge – which is indispensable for the human intellectual development of the individual –, on the other hand, more recently, technological advances have been promoting greater integration in the field of engineering, which means requiring a more prepared professional, with "[...] a profile of a worker marked by flexibility in face of changes, investing in his permanent training and that is opened to new challenges, an entrepreneur of his own that would guarantee his employability and permanence in a market in continuous transformation" (LIMA, 2010, p. 160).

Hence emerges the inherent contradiction of the teaching of labour: a better prepared professional is required in the midst of the limitations of human intellectual development that these political-educational guidelines suggest to the teaching and learning process in technical education. Therefore many people are led to believe that it is only through the experience of the act and the practice acquired at work that it is possible to prove the effectiveness of an idea, the latter characterized by the materiality of a particular object and by the success of solely the results obtained.

The elaboration of the new curricular design of technical courses from private schools changes from a structural base constituted by contents to a description of fragmented contents, which are subordinated to some kind of learning delimited by technical capacities, what results in a curricular structure based on the operational field. While the previous educational guideline (SENAI, 2002) privileged autonomy in the planning and development of the discipline's work plan, which allowed the creation of a living curriculum in relation to the students' knowledge and practices; the new systematization (SENAI, 2009) makes the teacher a mere executor of a curricular proposal. Now, the curriculum is idealized by a Sectoral Technical Committee, that is a group formed by trade unionists, businessmen, professionals in the technical area, specialists in professional education (one of them can be the teacher), someone responsible for the school, among others. It is noteworthy that such changes arise in a scenario of international educational reforms. For example, Ball (2011, p. 178), by referring to the context of reforms in the United Kingdom, understands that this movement "[...] leans on a technique, the imposition of management procedures that intend to simplify and accelerate the decision-making process".

In Brazil, specifically in the context of the current vocational education policy of private technical education, it is understood that the educational changes implemented have made room for a curriculum emptied of theoretical knowledge, which radically changes the conditions for the development of humanizing teaching and learning.[5] The reason is that, by focusing the technical training only on the performance of tasks and on know-how, it does not create conditions for the integral development of the students.

4- Davidov (1988, p. 154) points out that empirical knowledge is only connected to the comparison, to the classification and to the representation of the object of study.

5- In order to focus on the job learning in human intellectual development of the individual and not almost exclusively on the needs of the job market.

Thereby, such proposal seems to contradict its own demand, proclaimed by the so-called job market, for training a professional capable of acting in unusual situations.

Fundamentals of a humanizing proposal in technical education

The contributions of the cultural-historical theory to learning in technical education bring to the fore the importance of concepts and the appropriation of theoretical knowledge by students in order to promote their own human development and, consequently, several solutions during learning activities that involve objects of study in the school and professional spheres. In this way, it is sought to build a pedagogical practice for technical education that is subject humanizing. We agree with Ramos (2001, p. 154) when the author states that:

> We believe that teaching and learning should lead the student to understand the social and historical process of scientific knowledge construction, making it possible for the student to do a critical reading of the world, to establish relationships between facts, ideas and ideologies, to perform acts and actions – voluntary or compulsory – critically and creatively, to understand and to actively build new social relations.

Reading the world in a critical and creative way, as Ramos (2001) argues, meets with the theoretical foundation of this research, highlighting the studies of Leontiev (2004) that explains the importance of his activity theory for human development through the labour activity. It consists in promoting the intellectual development of the individual through a social activity, i.e., performing an activity of preparation (internal) and another of execution (external), which are related in a dialectical unity. Therefore, the social activity needs to be structured so that their actions are not necessarily prompt to their particular needs and motives. Action is conceptualized by Leontiev (2004, p. 69) as "a process whose motive does not coincide with its objective (i.e., with what it is addressed to), but resides in the activity of which it makes part of".

In a complementary way, Davidov's (1981, 1988) studies characterize aspects of empirical and theoretical thinking, both important for the development of human thought. While empirical "catalogs and classifies objects and phenomena," theoretical thinking "pursues the purpose of reproducing the essence of the studied object" (DAVIDOV, 1988, p. 154). Thus, specifically empirical thinking is characterized by understanding only the immediate feature of the studied object, not fully revealing its internal connections. Thereby, learning based only on empirical thinking is characterized by being fragmented, revealing to the student solely the external appearance of the researched phenomenon. Theoretical thinking sublates (in the dialectical meaning) this condition, since it intends to reveal its essence through the investigation of its particularities, the connections of its internal details and the very process of constitution of the object (DAVIDOV, 1981).

By bringing such theoretical contributions to the foundation of a humanizing proposal in technical education, it is found that the search for the development of the students' theoretical thinking allows teaching and learning to overcome the mere fulfillment

of the job market demands and start to prioritize the integral development of the human being. Understanding that the teacher's teaching activity organizes the student's learning activity, three conditions are placed as fundamental in this process. The first one proposes an intentional teaching activity (MOURA, 2010), which requires the overcoming of merely reproductive teaching of the job market ordinary practices, however, by overcoming it, the student's sense of learning intensifies. The second condition suggests an education based on the development of theoretical thinking and, therefore, a deep knowledge of the object of labour, which seems to be opposed to the exclusive focus on the development of competencies (SENAI, 2009). Finally, the third condition is the promotion of learning activities, in which group discussions and dialogues prevail, focusing on group work.

In this way, the participation of the teacher of technical education – with pedagogical training – is essential in this relationship between teaching and learning, because it facilitates the intentional organization of activities in order to develop the students' theoretical thinking. In addition, the teacher plays a key role in the discussions triggered during the teaching and learning process, which considers the object of study to be in movement and the relations of its external and internal properties (DAVIDOV, 1981, 1988). On the contrary, the ideology of learning to learn (SENAI, 2009; POZO, 2002) preaches the student's habit to find for himself the answers for the problem situations, which in turn can refer to an unsuitable solution. Duarte (2001, p. 80), critic of this neoliberal conception, affirms that education, in the mold of neoliberalism, seeks to "make individuals willing to learn anything, no matter what, since it is useful to its incessant adaptation to the market winds". According to Saviani (2011a), such a dominant orientation disseminates the tragic idea of a disoriented student, who learns in the void.

By making such conditions conductors of the teaching activity in technical education, in this article, we present some indications of the development of the students' theoretical thinking, in the process of movement of their actions and activities, during the elaboration of technical projects (ARRUDA, 2016). In the following item, the methodological procedure of the research is described.

Methodological procedure: the formative experiment

The research was based on dialectical and historical materialism by reiterating the concept of contradiction[6] as a condition for the breakdown of the dominant way of thinking (FRIGOTTO, 2000). As methodological procedure the formative experiment was adopted, defined as a special method of investigation that aims at "the study of the particularities of the organization of experimental teaching and its influence on the psychic development of students" (DAVIDOV, 1988, p. 195). In this way, with the proposal of the execution of a project by the students, the experimental approach sought to put them in motion, creating the possibility for the teacher-researcher mediation – when it was appropriate – during the teaching and learning process and, thus, under the point of view of human development, provide

6- In the sense of comprehending that the phenomenon does not manifests itself directly, so it is necessary to investigate it in motion, reaching its essence to achieve the concreteness of reality, the totality (KOSIK, 2002).

an investigation of the possible dynamic and causal relations to this phenomenon (VYGOTSKY, 2007).

The research was carried out at a private technical school, located in the city of São Paulo. The class belonged to the professional technical course in the field of refrigeration and air conditioning, in the year of 2015, and was one of the last graduates of the projects discipline prior to the implementation of the new pedagogical proposal based on competencies. As a triggering situation, it was suggested to the groups the elaboration of projects based on the diagnosis of real situations encountered in the day to day work. Among the participants, twelve students were chosen, divided into two groups: the first one elaborated a real air conditioning project for a restaurant, and the other one chose to execute a project to improve cold storage rooms for banana storage. Both had the accompaniment and participation of the teacher-researcher in the process. In particular situations, in which there was a need for discussion on specific issues in the area to solve the problem, specialized teachers were invited to collaborate in guiding the work. Data collection was done through audio records, unstructured and semi-structured interviews, and access to the students' written productions at different stages of the project elaboration process. The research was authorized by the institution's ethics committee and all participants signed the informed consent form, and their anonymity was guaranteed in the final report.

The analysis methodology sought to make explicit the movement of students' theoretical thinking by means of isolates[7] (CARAÇA, 1951), which are detached from the totality of the facts and converge to the dialectical and historical materialism's concept of particularity. The isolates were divided into episodes, that are presented in the research as a means of extracting evidence and indications of the movement of learning that form totality among themselves. The episodes, in turn, consisted of scenes raised "with the intention of revealing the actions in the formative process" (MORAES, 2008, p. 135).

Reference to the data is made by the following coded structure: GX, Daniel, 12/02/15, ODSA; GX identifies the group (X or Y) followed by the participant's fictitious name (s), the date of the events and, lastly, the acronym for the kind of record/activity, which in this example means Orientation and Discussion in the Classroom. In dialogues involving participants from different groups, as well as teachers, there is the addition of this information, for example: P1, Jose; GX, Daniel, 12/05/15, RO.

The analysis of the data was done through three isolates: reality, contradiction and consciousness, which are presented next.

7- According to Caraça (1951), it is a cut of the totality that arises when observing the phenomenon in the course of a certain action. In this way, it is possible to reveal an unexpected fact previously ignored. "In the impossibility of embracing, in a single blow, the totality of the Universe, the observer cuts out, from this totality, a set of beings and facts, abstracting from all others that are related to them" (CARAÇA, 1951). Thus, in analyzing the students' movement in the course of the development of the study activity, the following isolates were extracted from the discussions: reality, contradiction and consciousness.

The development of theoretical thinking in movement: reality, contradiction and consciousness

The search for evidence of the development of students' theoretical thinking through the elaboration of a project, enhanced by the personal relationships engendered by the teaching activity, was substantiated in the analysis of the isolates reality, contradiction and consciousness. Next, there are some of the main points of the analysis, which allow to the research conclusions to be demonstrated.

Reality as a starting point

Reality taken as a starting point, especially in technical education, is an important way to awaken in students the sense[8] for learning. When direct contact is made with the object of real study (problem), the students begin to identify the external properties of the phenomenon, through visual generalizations resulting from the observation process. This process, when approaching what is experienced by working students in their daily practice, avoids an initial estrangement from theoretical solutions, common in the transition from the labour activity to the study activity. In this context, many questions are brought into the school environment, that generate dialogues between students and teachers. However, the emerging problem of this practice that takes reality as a starting point is the frequent search for immediate and empirical solutions to the project's problem, that reinforces a fragmented habitual practice. This practice, although often able to solve the problem, does so in a one-off manner by not considering the specific knowledge of the area and the analysis of multiple determinations of the problem. It is exactly the possibility of overcoming this condition that the analysis of the data allows us to demonstrate.

The isolate reality presents dialogues between teachers and students that explain a dialectical unity between teaching and learning in which the student learns with the help of the teacher, that agrees with the proposal of Moura (2010), who considers the teacher as the one who teaches and the student as one who learns. Surely, in this process, the teacher also learns and relearns to be a teacher. An example of the dialectical unity between teaching and learning is the following dialogue, in which the student Lemuel, during the project calculation, confers the technical standards by own means and mistakenly uses a recommended value for air change:

> Leoncio: What air changes are you using? What is the change fee per person?
> Lemuel: I think it's twenty-five.
> Leoncio: Twenty-seven.
> Lemuel: Wait a second, I'll take a look. Restaurant is 25!
> Leoncio: No, you can put twenty-seven. This is the standard recommendation, but the current ordinance is the Law! Did you understand? Standard recommendation is in case of an environment where there are few people, then you can decrease the value of the change, but the

8- "[...] the rational sense for man of that for which his activity is oriented" (LEONTIEV, 2004, p. 85).

> current ordinance, which is the Law, that obligates, is twenty-seven cubic meters per person. (P2, Leoncio; GX, Lemuel, 11/02/15, ODSA).

Teacher Leoncio, in this excerpt, highlights the importance of his role of teaching, which contradicts the pedagogical presuppositions of learning to learn, that makes the student responsible for his own learning, as Duarte (2001) points out. Another important matter revealed in the analysis is that, although there is previous theoretical background before the presentation of the real research problem to the student, for him the sense of learning is concretized in the direct contact with the objective reality. This can be evidenced when the student is questioned as to the difference of performing a real or an idealized project. He exemplifies: "[...] it is so because you are looking at [an architectural] plant, and that plant is not always with all the actual data. For example, you have piping going by, which is not indicated in the plant" (GX, Daniel, 01/02/15, ESE). For students, concrete reality allows the production of a personal sense for learning much closer to its meaning (LEONTIEV, 1983) than, for example, the suggestion of a fictitious problem of project idealized in the classroom.

In general, in the students' initial contact with the object of learning, problems are analyzed through both comparisons with practical work experience so as through knowledge of technical regulations. This relation manifested itself in a situation in which, when collecting data, the students observed that at the project site there were problems with the regulations of the Brazilian Health Regulatory Agency (Anvisa). When verifying that the products were stored on wooden pallets, they realized that, according to the ordinance CVS no. 6/99 of March 10, 1999, it could not be practiced, since it is banned on grounds of damage to consumer's health. The comparison between the observed reality and technical knowledge can be verified in the following comment: "At Anvisa, it is said that there can't be wooden pallet. Wood absorbs moisture, creates fungi" (GY, Juliano and Romario, 27/03/15, ODSA).

Thus, although it initially departed from the concrete reality, the formative experiment was directed so that all the information collected by the groups during the visit to the project site was analyzed in the light of a theoretical reference about projects. When planning a project, there is a need to identify the main tasks to be developed and to carry out a particular study on the relationship between them, since many can begin concurrently and others only after the completion of some to be initialized. In this way, the importance of the theoretical foundation is revealed even when beginning the study of the external properties of the real object of learning (the project site), as we can observe in the dialogue between teacher Jose and the students:

> Jose: What do you remember about there? [Shows the diagram of the project's critical path].
> Celio: Depending on the activity, you can see it clearly or not. You've got to pay more attention to it.
> Everton: Finding critical points.
> Jose: Critical points, okay. But what do we have here that we call activity relationships? Do you remember that we spoke about it?

> Daniel: The activities depend on each other. Some you can do in parallel and others depend on each other. (P1, Jose; GX, Celio, Daniel and Everton, 12/02/15, RO).

The importance of the didactic strategy adopted by the teacher resides in the intention of bringing the real object of learning closer to the theoretical foundations indispensable for the later study of its internal properties: "In theoretical knowledge it is determined the nexus of the universal relation, really existing, of the integral system with its different manifestations, the bond of the universal with the singular" (DAVIDOV, 1988, p. 154).

Direct contact with reality also triggers the process of classification of objects, which, according to Davidov (1988), causes the investigated object of learning to be explored in a superficial way, i.e., at this stage it is possible to understand the phenomenon only by its appearance (DAVIDOV, 1981, 1988). The dialogues, the relationship with concrete reality, the didactic orientation and the understanding of the difference between daily life and theoretical knowledge reveal themselves as essential conditions for the development of students' theoretical thinking in the technical school about projects, theme which is discussed next.

The contradiction[9]: resignifying practice

On this isolate, it was sought to analyze the students' approach between sense and meaning of the action in the contexts of professional jobs and technical school. Thus, reality presents itself again in research, now as an element of contradiction between the theoretical school fundamentals and some examples of ordinary work habits and practices. The contradiction allows the proximity between the reality based on fragmented knowledge and the proposition of theoretical foundations at school, in a movement of development of the theoretical thinking of the students.

Initially, it is demonstrated the use of resources for the execution of the labour that does not reveal the historically produced knowledge and disseminates quick ways of solution, encouraging the fragmentation of knowledge in professional learning. The usage of tables with ready-to-use results, specific applications and software legitimizes their own use for the ease and speed at which results are obtained. Learning through labour suggests a conditioned action by the application of these superficial problem solving methods and it can be highlighted in phrases such as "I took a look at the ASHRAE's table and for us to get minus five [temperature] I've got to have an insulator of a hundred and fifty millimeters" (GY, Julian, 11/02/15, ODSA, emphasis added) or "Logistics is addressing. IML, drawers. Look at the verticality, A, B and C. [...] *I've got a piece of softwar*e". (GY, Felipe, 26/02/15, RO, emphasis added).

Although the tables and programs have in themselves plenty of theoretical knowledge objectivised, which is necessary for the subjects to solve problems, it is understood that

9- The contradiction is understood in the dialectical and historical materialism as "[…] the genuine source of the movement, of the transformation of phenomena. The fact that opposites cannot exist independently of being one without the other constitutes the unity of contraries. Dialectically, both in unity and in struggle there is movement. In the struggle, the movement is absolute; in the unity, relative" (TRIVINOS, 1987, p. 69).

technical education that focuses exclusively on the use of such instruments denies the student knowledge and procedures of execution essential to their training and learning, in addition to understanding the essence of the object of study and work. The student's access to such information can lead him to the stage of creation of an object: "The movement that leads from perception to concept is equivalent to transit from the concrete and sensory to the abstract and imaginable" (DAVIDOV, 1981, p. 26).

As well as the use of resources depleted of theoretical knowledge, it was also identified, as an initial strategy for solving problems related to the projects that had been developed, the attempt to legitimize professional practices without proper theoretical basis. Many ordinary solutions end up being considered as examples to be followed by the workers, who disregard the problems that can arise from these solutions. For example, in air conditioning of rooms, the filter utilized in the air conditioner depends on the characteristics of the type of environment to be conditioned. When designing a machine, it must be considered the type of filter to be used for the equipment to be sized in order to withstand the pressure exerted by the resistance generated by it. However, many professionals modify the machine filter without considering this condition. In this way, the machine loses efficiency, because it has not been sized to withstand the resistance of the type of filter inserted. An ordinary practical solution is to tinker with the rotation of the machine shaft, which often solves the problem, but generates other consequences such as loss of warranty, shortening of service life, faster wear of components, etc.

If, on the one hand, exclusive accommodation in daily practices can be configured as a barrier to the development of student's theoretical thinking in technical education, there is, on the other hand, that the dialectical contradiction – unintentionally triggered by the teacher who understands the professional practice and at the same time is appropriated of theoretical knowledge – can be configured as the motor of the development of this same theoretical thinking in the student.

In the following dialogue, a student, Juliano, tries to justify the use of an equation, spontaneously indicated by a professional of the area, during the project calculation:

> Juliano: There was a different way of calculating it, it wasn't exactly what he showed me, the way he guided me. He said: *use this one*.
> Jose: You can't simply say that you have used that formula in your essay. You will explain the values, where they were taken from, and the references of the equations you have used are. (P1, Jose; GY, Juliano, 11/03/15, RO, emphasis added).

It is through this movement, of contradiction between theory and practice, that the student realizes the need to consult information and conceptions to support what is suggested, as it is seen below, following the previous dialogue, in which Juliano asks for information about a book and teacher Jose reinforces the importance of it:

> Juliano: Do you have the name of the book?

> Jose: Refrigeration. Principles of refrigeration. You can reach the librarian and ask for Dossat's book. Because we need to reference and have basis for everything we are doing, we can't simply do so, because so-and-so has told it. (P1, Jose; GY, Juliano, 11/03/15, RO).

In this movement, supported by the intentional action of teachers, the students assimilates theoretical knowledge that lead to important conclusions for the development of the school project and their own theoretical thinking, as it is possible to be noticed in the speech of a student, Denilson, in one of the work displays:

> In this case, it is known that infiltration is the major cause of thermal load. It is because there the windows are large, and are usually open, the bar door always remains open, it is a large door, it is one of those iron doors, and in this case there is large number of entries (GX, Denilson, 02/03/15, COD).

This conclusion reveals that the student made an analysis of the thermal load calculations that involves the concepts of heat transmission by conduction, insolation, infiltration, among others. By associating the characteristics of the project site with the exorbitant value found in the calculation of the infiltration, he justifies the reason for such perceived discrepancy, thanks to the result of the theory that was compared to the observation of reality. This understanding is called conceptual generalization, which occurs when the student is able to abstract "[...] analogous qualities in all objects of the same type or class which are considered to be common" (DAVIDOV, 1981, p. 13).

Another important fact revealed by the analysis is that one group, at first, idealized only an improvement of a cold store project. They were convinced they could take advantage of the existing equipment on the project site, as these were new and had been recently installed by a company. When comparing the data obtained with the observations of the storage process, they concluded that such reuse would not be practicable.

The students found that the high energy consumption problem was due to the process of moving products carried out by the employees. They left the door open for a long time, which led the currently installed equipment to be oversized. This conclusion also justified the considerable increase in energy consumption complained by the owner. The movement of learning carried out by the students is explained by the principle suggested by Vygotsky (2007), who advocates the analysis of the process to understand its developmental conditions. In a complementary way, it can be understood that the knowledge of the object's essence, in this case, the process of cooling bananas in cold rooms and their relations with other factors influencing it, are indications of theoretical generalizations, which "correspond to deductive reasoning, the movement from general to particular and from intrinsic to extrinsic" (DAVIDOV, 1981, p. 34).

The movement of appropriation of theoretical knowledge aimed at resolving problems is thus revealed through discussions between the teacher and the students in the class, in a more solid and consistent way. In this way, the episode demonstrates part of the movement of awareness of the students, that professional practice is not sufficient to meet the conditions for solving a more complex school problem. The fragmented means

of applying professional practice are revealed to the students, who depart for a possible overcoming of this condition. The episode presents indications of the appropriation of fundamentals, mediated by reality, by school work, by group discussions and new sense for students' learning.

Consciousness: the student's sense of learning

The signs of students' awareness appear from the moment in which they can differentiate an empirical and ordinary solution from another based on knowledge. According to Leontiev (1983), a conscious operation begins as an action, in other words, as a process directed indirectly toward a collective goal. Vazquez (1968, p. 191) defines the activity of consciousness when it "manifests itself as the production of knowledge, i.e., in the form of concepts, hypotheses, theories or laws by which man knows reality". For the purposes of this article, we chose to bring some excerpts from the interviews conducted at the end of the project development activities, which allow us to present the sense of learning theoretical knowledge to the students. In most students' answers, it can be noticed that theory and practice are understood as distinct categories of knowledge, but that complement each other when solving a problem, which is observed in statements such as: "theory is a fundamental step for succeeding in practice. Practicing and having theoretical knowledge make us understand the reasons, make us visualize the project before its ending, and it can even innovate and improve this project" (GX, Lucio, 18/06/15, COSE) or "The guy who has started to work in the field, if he has an open mind, he will do well in the theory part, because the theoretical part will add to the practice that he has" (GX, Everton, 18/06/15, COSE).

Empiricism in solving a problem and alienation in the exercise of the profession appeared in the analysis of the difference between school and work. In the speeches of the students, signs that confirm the conditioning practices of the market are revealed: "at work you perform many services that you can't say why" (GY, Romario, 18/06/15, COSE) or "[...] in a company where people work with the products and systems of the manufacturers, you have to toe the line, you can't get out of it" (GX, Daniel, 18/06/15, COSE).

Many students confirm that the technical school – given the developed proposal of teaching organization – is the place where limitations of work practices can be overcome, thus, one of them comments that "Here we do the project, we exhaust all possibilities. At work you don't have that opportunity" (GX, Daniel, 18/06/15, COSE).

The notes indicate a certain awareness of the students in relation to their own condition experienced in their daily work and the different learning opportunities intentionally suggested by the activity of teaching in the school. In this sense, it is possible to realize that they have not only transformed the object of study, but themselves, recognizing the importance of knowledge for their own intellectual and human development:

> I found it impossible in the beginning because I had no information of what to do. Then I placed it as possible, because with the project course we took step by step reaching the end and getting to know, yes it is possible, because we acquired knowledge. (GY, Romario, 18/06/15, COSE).

Thinking theoretically implies understanding the process of object development through the knowledge of its external and internal properties (DAVIDOV, 1988). When the student relates learning as a way to improve the quality of his hands-on activities, he changes himself and the way he understands his work. He begins to have the possibility of acting with autonomy, creativity, as the student who has shown signs of altering his convictions regarding the development of a project, when reporting that:

> For me a project has always been something like that, someone has to do it, so then you can start your task. Now, after the course, I've begun to see that you are also able to get there and develop one. (GX, Everton, 18/06/15, COSE).

In analyzing the difference between school and work, students demonstrated awareness of the possibilities for personal development under a humanizing conception of professional education as opposed to an alienated practice imposed by the job market. Such condition promotes limitations to the development of theoretical thinking of the subject by inducing him to reproduce rushed tasks and basically aim at the results and not the human development of the people.

Thus, the domain of knowledge becomes a condition to understand oneself within the system of alienating production of professional practice. With it, the student gives meaning to his own learning, that seems to differentiate and overcome empirically produced ordinary teaching, which until then had been considered the easiest way. However, as Vygotsky (2007) argues, good teaching anticipate itself in face of one's development to promote it, overcoming limits and advances on new possibilities of action in the context in which the subjects live.

Final considerations

The results of the research reveal that it is possible, in the midst of an extremely contradictory and dominant context, to promote a humanizing education for technical education students. It is not a matter of denying the teaching of ordinary technique and practice, but rather of overcoming the limits imposed by both to the development of human thought. It is understood, therefore, that the technical school needs to promote learning aiming at the appropriation of knowledge and concepts that go beyond the technique required for the job market. It is not suggested the denial of the operation of technological resources, but the overcoming of it, in the sense of comprehending the creation itself, or even of the investigation during the development process. The research makes it very clear that "[...] the content and methods of school instruction, established prior to the present technical-scientific revolution, do not meet these new requirements" (DAVIDOV, 1981, p. 5).

The conclusions of the study presented here demonstrate some evidence of the development of students' theoretical thinking. The facts were exposed by the movements identified as the isolates reality, contradiction and consciousness. Reality is defined by the direct contact of the student with the object of study, which brings meaning to learning considering the context of work, and presents the external appearance and characteristics of the phenomenon. The contradiction is revealed by the conflict of the solutions of the practice of labour with the theory based solutions, that suggest more deepening of the subjects treated. The division of intellectual and manual labour advocates a limit (MARX; ENGELS, 2001) that can be overcome by the student through the possibilities of learning generated by the organization of the teaching activity. The student tends to recognize such alienating imposition, provided that the dialectical movement of contradiction indirectly exerts influence in face of his own reflections (TRIVINOS, 1987; DAVIDOV, 1981, 1988).

The isolate consciousness represents the movement of ascension from abstract to concrete (DAVIDOV, 1981), that is evidenced from the moment in which the empirical solutions are refuted, a timely opportunity to suggest another theoretical solution based on the analysis of the external and internal properties of the object of learning: "The concretization of theoretical knowledge consists in the deduction and explanation of the singular particular manifestations of the integral system from its universal foundation" (DAVIDOV, 1988, p. 154).

All these isolates, in a dialectical relation, bring evidence about the constitution of student's theoretical thinking in the concrete-abstract-concrete movement (DAVIDOV, 1988), in other words, he starts from concrete reality, abstracts amid contradictions and idealizes a concrete thought, aware of its foundations and basis, to solve the problem.

Another important contribution of the research is the emergent role of the student-worker as a questioner and a change agent of the contexts and situations in which he is inserted. Through the humanizing proposal, the student will take a more critical view of superficial and pragmatic solutions that are often presented by daily practices of colleagues in the profession or by the lightening methods standardized by companies. This situation relates to the research carried out by Engeström (2013), which refers to the misconceptions of students who try to understand empirically the phases of the Moon. According to the author, changing and overcoming this condition requires entering the context of criticism, the latter supported by contradiction, debate, resistance and questioning.

The student's activities in the classroom need to be oriented, since learning requires didactic paths and the organization of the teaching activity (MOURA, 2010). The constitution of theoretical thought manifested itself in the clues and evidences presented during the course of the research. Ordinary and empirical knowledge would not be sufficient for the student when faced with a complex problem that requires theoretical foundation for its resolution. In this way, the development of theoretical thinking presents itself as a suitable means for professional training, because it enhances the human condition of self-development, reestablishes the need for knowledge that is historically produced by society, and overcomes the learning of purely operational actions that are each time more imposed by the advancement of new technologies.

The research reinforces the idea of polytechnic or polytechnical (SAVIANI, 2003; MACHADO, 2015), that emphasizes the overcoming of the separation between manual and intellectual labour, which "[...] means the union between intellectual and manual labour or, more specifically, between intellectual instruction and productive labour" (SAVIANI, 2003, p. 144). In spite of the arguments against the term polytechnical (NOSELLA, 2007), the present study focuses on the question of a pedagogical practice, in the classroom, that intends to promote self-reflection of the student-worker on the context of work practices. The results also converge to the ideas of historical-critical pedagogy (SAVIANI, 2011b), of human emancipation, but this would only be possible by overcoming the barriers imposed by educational and institutional policies that go beyond school education.

The importance of the students' awareness of their own actions emerges from the activities and dialogues suggested by the teacher to the subjects within the school space. It makes possible the reflection on the object of study in order to understand the real difference between theoretical thinking proposed by the technical school through mediation of labour and the empirical and daily practice disseminated in the background of service provision and roles performed in the work field. Learning with a view to the student-worker's human formation may well meet the demands of the job market, but research has shown that overcoming know-how through theoretical thinking raises the student's creativity condition and makes him reflect on the alienation imposed by the culture of labour.

The use of software and applications has led to learning by a way of reproduction of rushed and limited knowledge practices. Both the student and the teacher in the technical and technological areas are conditioned to believe that the purpose of their work is only to present the result of their action. Thus, all the epistemological conceptions that ground learning based on individual capacities, sovereign to theoretical knowledge, legitimize at the same time fragmented, disconnected of the whole knowledge, superficial enough to solve some daily problems, but not for defending the goals of a teaching aimed primarily at human formation and, consequently, at solving more complex problems.

It is necessary to understand that the operative model of the practice by the practice itself is not enough to potentiate the human development of the individual in the world of labour. This change comes from an educational process organized and planned intentionally to propitiate the construction of theoretical thinking, since professional training cannot be tied to mere ordinary activities or learning to learn: "Transformation comes from the process of living reality, learning this reality in thought plan and, therefore, a method is needed, which is represented in survey by dialectical and historical materialism" (ARRUDA, 2016, p. 219). This process is ontological so that professional education must take place in relation to labour, but essentially, through labour and not exclusively for labour (MORETTI, 2007). Thus, labour is an educational principle and organizer of a pedagogical practice of professional education focused on formation.

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