

TRADITIONAL TEACHING METHOD: CRITICISM AND PERSPECTIVE OF A NEW PATTERN FOR THE TEACHING OF ENGINEERING

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Abstract — *The traditional method of teaching is, no doubt, the most used among university teachers. Practically, the whole educational system of the nation adopts it, except for pre-school institutions and some schools that teach the fundamental level, the so called “constructive” method. Expository classes, explanations of formulae, sequential tests, condensation of knowledge into disciplines, and laboratories in which measurement and observation are overvalued may be considered characteristic of this traditional method. This paper analyzes the possible sources that originated the traditional teaching method, exposes part of the most common criticism about it, and presents a new perspective trying to modify it, based on the scientific theories of Vygotsky, Leontiev, and Davydov.*

Key words: Activity Theory, Teaching of Engineering, and New Pattern.

INTRODUCTION

An overwhelming amount of literature deals with the “crises of education” or with the underlying philosophies about the subject [1].

The specific literature we investigated nevertheless is silent about the scientific treatment of the process that involves teaching-and-learning at the universities.

The traditional method is, no doubt, the most widely used in Brazilian Universities. Almost all the educational system adopts it, except for pre-school and some basic level schools, which adopt the “constructive” method. Expository classes, explanation of formulae, transposition of sequential tests, condensation of knowledge into disciplines, and laboratories in which measurement and observation are overvalued may be considered characteristics of this hegemonic method in Brazilian schools.

In the next segment we analyze the source of origin of the traditional method. Next, we show the commonest criticisms to it and, then, we present a new perspective for change, based on the scientific theories of Vygotsky, Leontiev, and Davydov.

TRADITIONAL TEACHING METHOD SOURCES

In [2], Saviani presents three theses about the teaching process in 1st Degree Schools. One of these theses states that the traditional method has its origins and was studied by means of the Herbatian pedagogic methodology, that is, “in the expository method, which we all know and have been

exposed to it, and many are still being exposed, the theoretical matrix is found in Herbart’s five formal steps”.

Note that in [5] the author, writing about “the traditional approach to the teaching process (not about the traditional method) states that this approach is not implicit or explicitly based in empirically validated theories, but in an educational practice and in its transmission through the years”, since it presents in its genesis several theoretical tendencies, both scientific or philosophic about man, the world, the school, etc.

In other texts we may find that the method, not the approach, really comes from generalization or, in other words, from Herbart’s steps hegemony and in the so-called formal disciplines [13]. In Brazil, elements from other scientific theories and ideological standpoints were added to this method, especially North-American behaviorism and technicism. This can be inferred by the context in which changes in Brazilian education were carried on at the time of the political dictatorship begun in 1964, as presented in the famous Rudolf Atcon report [4]. From what has been exposed, we may consider the origin of traditional pedagogy as Herbatian.

MOST IMPORTANT CRITICISMS

The traditional teaching is multi-faceted and may be criticized from several standpoints.

Criticisms are always based on its concrete characteristics, and the pre-supposed theoretical and/or philosophical and/or scientific ideas that would justify this didactic attitude.

From the concrete characteristics, we may outline some of the most important: several students seated on desks (depending on the teaching level, we will have a number between 15 and 60!) before a single person who relates the lessons, the contents, and the subject. A moment to clarify doubts and answer questions. Then, homework or some kind of example. A test. The process is now repeated with new contents. These are the main characteristics of the so-called academic school. In some other types of schools (technical, universities) we add a laboratory and several technical experiments to consolidate what has been taught. Tied to this panorama are implicit different viewpoints of the world, the student, the learning process, and we cannot, at this point, homogenize existing ideologies: each teacher will develop them along his school practice.

Once the picture of traditional teaching is characterized we may now look for the presuppositions of this caricature.

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Johann Friedrich Herbart (1776-1841) was an eminent German philosopher and a skilled teacher. He was the first to develop a learning psychology to justify the “clean slate” theory (derived from Locke’s empiricism) by mid XIX century. His psychology was metaphysical and speculative and was based in his own teaching experiences. Therefore it was not an experimental psychology yet. In his view, psychology should be introspective. The four stages of Herbart’s method were: clarity, association, system, and method, which his American followers extended to five [9]. These stages were looked upon as a general learning method. The so-called Herbart’s formal steps that originated the fundamental teaching are the following: *preparation, presentation, assimilation/comparison, abstraction, generalization, and application* [3].

These steps, if watched attentively, are nothing else than Bacon’s scientific method: observation, generalization, confirmation, which are also the reasoning inductive method.

The similarities with traditional teaching do not end here. The renowned class-plans that teachers used to create have their origins in it. Today, not used any more, they were replaced by the emendations.

The practices arising out of this approach required total discipline and attention from the part of the students to the topics presented by the teacher who, on his side, should follow in detail the steps outlined in his lesson-plan, etc. This discipline, focused on total attention, justified the punishment methods so far imposed or, at least, provided subsidies to them. According to Herbart himself the teacher is supposed to disguise any debate from the part of the students by means of an undisturbed disapproval and “wait till fatigue takes care of them” [9]. Needless to say that other disciplinary techniques such as the palmer were considered more efficient to calm down and impose attention from the part of the rowdy and heedless students. The passiveness of the students arises as a result of Herbart’s metaphysical philosophical conception in which active are the ideas, not the persons.

Philosophic Presuppositions

The philosophy underlying this method is Locke’s sensory empiricism but without a materialist, objective, character. Whereas, according to Locke, learning comes from the interaction of sensory experience with the environment, and this shapes the minds of the persons, who are morally neutral and passive in terms of action, to Herbart everything happens in the heads of the students. It is a world of ideas, perceptions. The ideas, however, have autonomous activity; they live by themselves. Afterwards, Kant, Hegel, and others, being replaced by objective empiricism, criticized these ideas.

Power Structure

Until now, we live a “Herbatian” culture. The palmer was replaced by more subtle tactics of punishment. The

established knowledge provides “ex-cathedra” supremacy, and this improves discipline, dismissing the use of power. The use of negative points, second-chance tests (generally more difficult), the exclusion/repetition of the “rebel”, “problematic” students, permeate the school structure and end up by taming the student, hegemonically producing “docile and submissive bodies” [8].

It is, above all, an excluding and discriminating process: while the “good” students receive the prize of promotion, the “bad” students will repeat, repeat, and repeat... there is no interest in their recovery and reinsertion. If the student does not learn, it is not the teacher’s fault! The evaluation is based only on his behavior and on the tests. The student, having no alternatives, memorizes, cheats; what really matters are the grades, to pass easily in all disciplines, knowledge being something secondary in this homeopathic sadism [7].

That is the watch and punish procedure that Foucault and Tragtenberg indict [8]. The school structure, with its roll-calls and ringing of bells, remind us of the of control of the labor forces and the prisoners in jail.

Behaviorism – Technicism

This metaphysics was, little by little, replaced by objectivism and technicism. This happened with the help of behaviorism that proclaimed a programmed instruction, the teacher being a mere extension of the technique and of the teaching instruments. This psychological current admonished the stimuli presented by traditional teaching were presented in a way too slow to provide a reinforcement contingency. The stimuli were based more in negative (punishment) than in positive (prizes) reinforcements. Although behaviorism criticizes traditional teaching methods in some aspects, the ones about reinforcement contingency, it has amalgamated itself so strongly to traditional methods that it is hard to say where is one and where is the other. This is because it has just modified the use of the “stimuli”, besides upholding the use of prizes and/or punishments, and the repetition of exercises (memorization) to avoid the *extinction* of an answer. However, behaviorism did not attain itself to other important aspects such as the student’s epistemology. Well, for behaviorists only what can be measured and seen matters. Conscience is a black box and so, left to the rats...

The New School

The objective empiricism was readily replaced by pragmatism, forming what was called progressive pedagogy of the New School, its most important exponent being John Dewey. For Dewey, what was important was the learning experience. He criticized Herbart because he took into account everything that was important in education except the essential – “a vital energy searching for an opportunity to effectively exercise” [9]. This way, the central focus is now the student and his actions; not the teacher and the content.

Considering Herbart's teachings, we may find five steps in open contradiction with Dewey [3], very widespread today by what we came to call a learning process based on problems: activity, problem, data, hypothesis, experimentation. Observing this scheme attentively, we will notice a parallelism with the hypothetical-deductive method. While Herbart used the inductive method, the New School and its followers opposed it to the hypothetical-deductive one, being confirmed by contemporary philosophic tendencies such as in the case of the "Viena Circle", and of Karl Popper, among others.

Other Pedagogies

Saviani tries a synthesis of these two educational tendencies, proposing a "content pedagogy", the steps of this synthetic method being: "syncretic" social practice, problematization, instrumentalization, catharsis, and "synthetic" social practice [3].

The scientific method would be the one proposed by Marx in his "Introduction to the Criticism of Political Economy"

In his work he upholds some points of Herbart's method and severely criticizes the progressive pedagogy. However, he sins when he considers progressive pedagogy a pseudo-science because it appeared, as well as traditional pedagogy, from personal experiments of their mentors. And, although both are based in different methods of logical analysis, both of them may be considered scientific, even deserving mutual criticism.

Paulo Freire is another great educator that used to criticize the traditional method on account of its bureaucratization, its insistence in mechanical memorization. He called it "bank teaching" because what mattered was the building up of knowledge, its authoritarianism (the center is the teacher), its micro-reproduction of social dominance. He opposed it with the Pedagogy of the Oppressed, that aimed to produce liberty, not by means of an overwhelming amount of reading, but by reading the world by the oppressed viewpoint, in a horizontal dialogue, consequently democratic, between teacher and student.

There are other pedagogies that could be dealt with: by competence, nowadays a colloquialism in the building up of curricula, Ausubel's meaningful apprenticeship, the ideas of J. Bruner, the field-gestalt theory, etc., but they will not be discussed here.

Piaget's Epistemology

Piaget's epistemology may be one of the most consistent criticisms to the traditional method. Nowadays it is one of the most used in grade school.

Today it is hard to find someone who calls himself traditional in pre-school (even in a worldwide sense). Owing to the lack of space in this paper, we will not consider its details, stressing only its main criticism: the school uses very poorly the spontaneous character (in Piaget's concept) of the children's thoughts, totally forgetting its episteme, and how

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much it could profit from the lack of equilibrium of the mental schemes already formed in a child's mind. Besides, of course, the over-valorization of the heteronomy and the lack of construction of autonomy by the part of the students [10 e11].

As one may notice, the criticisms to the traditional teaching method are innumerable and even consistent. Nevertheless, we may place a question: why, then, still today, at the very beginning of the XXI century, such an archaic method is used in Engineering courses?

A NEW PATTERN

All the literature presented offers a consistent criticism but fail to provide the teacher with elements that may help him in his daily task. Besides that, all the theories seen so far are unsuccessful in this aspect for they are either pure philosophical speculation (Saviani, Gadotti, Tragtenberg) or emphasize either infantile education (maybe up to 16 years of age) or adult education (Piaget and Paulo Freire). It is not in vain that teachers of technical areas raise comments such as "pedagogy is for children", or "this is something for sissies" We really need an educational theory scientifically based, that may be used by teachers as a didactic guide.

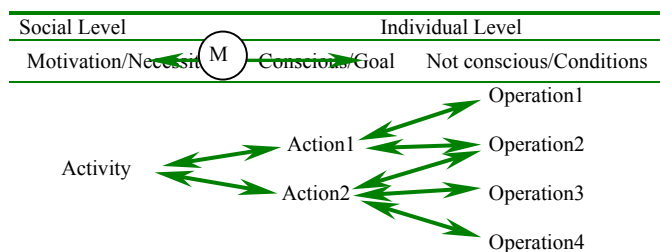
Developmental Education

Developmental Education (DE) originated in old USSR, as an outcome of the historic-cultural theory presented by Vygotsky, Leontiev and Luria, later developed in its theoretical aspects by Davydow, Galperin, Elkonin, Lompscher, Chaiklin, Engeström, among others. The philosophic presuppositions of this theory return to Hegel, Marx, and Engels.

The term DE reflects the basic idea presented by Vygotsky that "adequately organized learning turns out into development" [12, 15]. Reference [16] presents briefly some theoretical concepts proposed by Vygotsky and Davydow.

The main concept of this theory comprises learning activity. It arose from the concretion of the general concept of activity made clear by the Activity Theory (TA) (Table I)

TABLE I
STRUCTURE OF ACTIVITY, BASED IN LEONTIEV.



Still, it is worth taking into account that the concept of Activity has a different meaning for the Russians in relation to the Latin language. It is a lot more than a specific action;

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it is a group of actions aimed at the satisfaction of a social necessity and so it may never be looked upon as something individual. It is also a unit in the analysis involving action-emotion-cognition.

The so-called developing education, then, is fundamentally based on the structure of what is known as learning activity. Beyond the relation between activity-motivation, action-purpose, operation-condition, other aspects are taken into account such as the use of psychic instruments of mediation (formation of scientific-theoretical concepts), confining of the action, zone of proximal development (ZPD) and analysis of the discipline [14].

This theory shows itself, then, as something that may be used beyond youth, in spite of the learning activity not being the main activity of the students in this period, and, most probably allowing the teacher to move inside the entangled curricular grid of the engineering course [15].

In this approach, the teaching aim is to give birth to a theoretical thought about reality in the student's minds, expanding a merely empirical thought (to distinguish between the one and the other, see [6] and [16]). If the exposure method is empirical the level of thought of the students will be the same, that is, he will be unable to associate what he learns and the surrounding world.

The main strategy for an educational process to produce development is considered in this theory as an ascending from to abstract to the concrete, typical of Marx's dialectic method; that is, to develop an essential relationship that characterizes an area of knowledge and find out how this relationship appears in several problems. This strategy is oriented towards the conscious and systematic formation of the student's own activity. Besides this and according to Lompscher, "it is important to consider that motivation only arises from activity; it cannot be transferred to the students. This implies the fact that didactics is something that must be oriented towards the actions of the subject that prove necessary to master the contents and the psychic control of the action". In other words, we should pay attention to the unit activity-object-concept and perform a logical and psychological study of the object of the area being studied [14].

Another important point is the analysis of the previous mental conditions of the students. To bear in mind the inter-relationship between internal-external, and ZPD.

Well, if we look upon traditional teaching of Engineering we will see that it tries to transmit something essential by means of concrete examples (i.e. overemphasis measurements of concrete cases without essential inter-relations in the labs). As the student has no psychic tool to adequately manipulate these examples, he remains in the surface, in the outer aspects of the phenomenon (empirical thought). Thus, the students will not be able to make out the differences between the essential characteristics (of content) and the general, or specific ones (formal) [6].

Expository classes and the use of several examples end up, then, overloading the students memory and they do not

have a mediating element (psychic tool) to act as a link to the several objects of study and act as an anchor for memorization. This mediating element cannot, however, be formed haphazardly [14]. It is necessary to analyze the discipline, to study the hierarchy of concepts in order to find the one that permeates all the objects of study.

To explain the subject, the teacher must, then, start his work by means of this initial essential relation (ER). This will be gradually enriched and discovered by the students in the handling of the objects/phenomena (O1, F1, etc) being studied, in the transformation of the representative models (Mod.) flowing from this manipulation and by the study of their intrinsic properties (Pro.). The highest point of this activity will be the use of essential abstraction in several problems that will be presented, developing a theoretical thought (Figure 1).

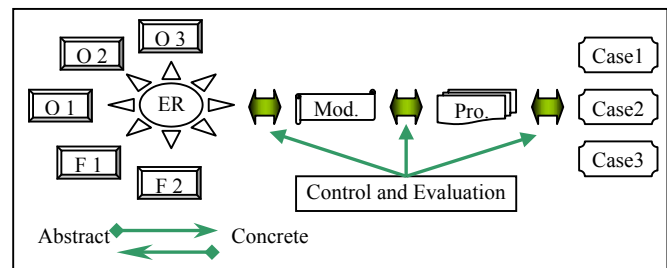


FIGURE. 1

STRUCTURE OF LEARNING ACTIVITIES AND THEIR TYPICAL ACTIONS

Reference [15] shows how to use this analysis of discipline to find the essential generalization (scientific-theoretical concept). This concept many times is something simple and trivial, but fundamental to the organization of the learning activities. It will be the lost link between the sensory aspect and the intrinsic essence among the objects and/or phenomena being studied.

After the previous study of the essential relation, or relations, the teacher should study the necessary actions for the *full* and *independent* development of his students.

We may point out the following as typical actions concerning the learning activity [6]:

- Motivation: the students should learn to evaluate their present way of action, which proves insufficient to solve a new class of problems. This is the moment when the learning activity goals appear.
- Modeling: building up of a model that will settle the essential relation in a material, graphic or literal form, by means of the transformation of the conditions of the proposed material situation.
- Analysis/Synthesis: a study of the intrinsic properties of the relation raised before, which happens by means of the transformation of the models that have been built.
- Expanding: application of the essential relation to the solution of specific problems.
- Auto-regulation: control of the preceding actions, both by the students and by the teacher.

- Evaluation: we confirm the internalization and the independent use of the essential abstraction in new problems.

CONCLUSION

Young teachers, especially those from engineering and technological areas, suffer from being totally unprepared in what concerns the origins and ways of teaching. The way they were taught, they teach. Some head for “alternative methods”, try to conform their classes to a context, etc. Somehow, even though these tactics prove necessary, they are insufficient for an effective teaching.

Besides that, the teachers of a technological area, may come in contact with pedagogic theories in didactics courses but these will be presented empirically. Thus, many will feel the necessity to change their teaching techniques but will be unable to do it.

Dewey, Saviani, Gadotti, Tragtenberg and Paulo Freire, all of them educational philosophers, have different opinions about the pedagogical momentum. Even though their personal experiments may have contributed a lot for the development of teaching methods, they lack a scientific-theoretical basis to lay a foundation *specific* for engineering teachers; that is, they say a lot about “what” to change but are of little help in what concerns “how” to perform their daily activities.

Much of what has to be done may be inferred from Piaget, but that applies to pre-school teaching. Piaget, in his theory, was interested much more in developing the individual’s cognitive structure performed spontaneously than in his school formation, as he himself stated: “I am a psychologist, not an educator” [11]. In spite of that, many Brazilian educators have wasted time in an inactive and unsuccessful discussion, contraposing or identifying Vigotsky and Piaget, and they would fare a lot better by studying something more up-to-date...

Yet, we may not simply blame the teacher, subdued by the lack of time, by the power structure, as we have shown above. How to remain gentle in overcrowded rooms? How to keep the students’ attention? Besides, time is pressing, “time is think”, in this crazy run against the clock. School subjects may be planned with excessive or insufficient hour loads, the contents may be crumbled, the knowledge fragmented. What to do if the student lacks a meaningful context: to teach this in spite of it, or step over the student’s ignorance? What to do if the matter has already been studied formerly? How to motivate the students?

The structure of the curricula places gaps or superimposes contents. As teachers normally act differently, how to warrant this inter-disciplinary dialogue? When will the teachers be able to discuss such matters? Time passed, the semester is coming to an end. Now the question arises: what to do with the students that were not able to follow the teacher?

DE presents itself as a new pattern for engineering. It points out the necessity to study the school subjects from a new angle, and to analyze curricula from a different standpoint, one that goes beyond formal aggregation of disciplines (pre-requisites).

It is necessary to group similar disciplines and form conceptual modules (“kernel”), We must use the innocuous existence of the school units to formalize groups of side-studies and redefine the teachers’ activities as well as the students’. The educator must be educated in order to educate.

Either we dare to relearn how to teach, educate (science of the process teaching/learning and its special activity) or this picture will emphasize the exclusion of the critical knowledge of the world even more.

Paraphrasing Marx, it is necessary not to thing the educational action in different manners; what matters here is to transform it. Paraphrasing Lenin, without a revolutionary theory, we will not have a revolutionary didactics. The DE is a prospective towards that...

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