

The Meaningful learning In The Control Engineering Teaching

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Abstract

This work presents a proposal for the teaching practice inside the discipline of advanced control in a course of Control Engineering. The theoretic base of the proposal is the meaningful learning theory of David Ausubel associated to the concept maps of Joseph Novak. To orientate the Project of the didactic pedagogic experiment and the methodology of the teaching practice proposed is used the theory of the mediator evaluation of Jussara Hoffmann. Instruments for the collects of data are proposed to support the theories used in the concept of the experiment. The results of the use of the didactic pedagogic experiment conceived are presented in a form of concept maps of the students, in a form of line of the time, proving the evolution in the concepts of the students. The analysis of the maps is done on the meaningful learning theory. The regards about this new method are presented to the end of this work

1. Introduction

The emphasis in the teaching of techniques replacing concepts results in a quick forgetfulness. The teaching of the theory disconnected from the practice aspects doesn't prepare appropriately the student for the profession. (VALLIM et al., 2000).

Nowadays, initiatives have been appearing to alter the reality presented by Vallim et al. (2000), one of the ways that arise as a possible solution for this problem is the theory of the meaningful learning (AUSUBEL et al., 1978) and its use in the teaching practice. Several works have been using such theory for improvement of the process teaching-learning such as Moreira and Dionisio (1975) and Silveira (2008).

The theories selected for the pedagogic-educational conception of this proposal have, like principal argument, the attempt of approximation of the Control Engineering Teaching, typically comportmentalist, to the paradigm most adapted for the construction of the knowledge, learning of concepts and of the competences inherent to this professional. These theoretical presuppositions are based in the theory of the meaningful learning of David Ausubel (AUSUBEL et al., 1978), the concept maps of Joseph Novak (NOVAK e CAÑAS, 2006) and the mediator evaluation of Jussara Hoffman (HOFFMANN, 1996).

The meaningful learning is used as central learning theory in this work due to its adherence to the engineering teaching. For Ausubel, subsensors are necessary for the appearance of the meaningful learning. The subsensors are a concept coined by Ausubel to represent the prior knowledge that the student has on a given content and that is present in his cognitive structures.

The concept maps will be used in this work like forms of representation of the knowledge of the individual. Through this, it will be possible to check the evolution of the net of concept connections presents in his cognitive structures.

An environment that provides these experiences associated to a teaching practice and plan of class appropriate to a model more participative of teaching-learning, will be able to take the apprentice to the called meaningful learning. For so certain aspects cannot stop being mentioned, mainly the evaluative process.

In the context of the formation been based on paradigms that are constituted from the constructivism, the pedagogy critic dialogic and socio - interactionist, the education evaluation is not separated from the great processual set that shapes the formal school and university education. It is intrinsic to the educative practice, to the teaching and to the learning (AHLERT, 2002).

Understanding that the process of evaluation of the learning must be continuous and present along the whole period of teaching-learning, an evaluation is like an evidence for checking of the result while solving a punctual problem, it will not be able to represent all the knowledge built in the cognitive structures of the student. Soon this work appears like a proposal to attend these aspects inside a course of engineering of control and automation.

Having in mind this context is necessary to set out how relevant, as well as to situate the reader in this proposal. For so, are presented the theories of the learning that compose the theoretic referential for the formulation of a new pedagogic model for the teaching practice in engineering of control and automation. The characterization of the proposed model also is presented in the final considerations of the study.

2. The meaningful learning

The theory of the meaningful learning was created by Ausubel being, subsequently, propagated and investigated in several areas of the knowledge for investigators like Novak (1977), Moreira (2006) among others.

Ausubel propose that, to the learning have really modifying effect in the cognitive structures of the individual, is necessary to be significant. With this premise, Ausubel suggests the necessity to define the meaningful learning and his opposite, the learning not significant.

According to Ausubel et al. (1978):

It is important to recognize that the meaningful learning (independent of the type) does not mean that the new information forms, simply, a sort of connection with preexistent elements in the cognitive structure. On the contrary, only in the mechanical learning that a simple connection, arbitrary and not substantive, takes place with the significant preexistent structure. In the meaningful learning, the process of acquisition of informations turns in change, such of the new acquired information as in the specifically relevant aspect of the cognitive structure to which that one is connected.

Ausubel detaches still that, the learning to be significant needs some points in individual: that the student is motivated, interested in learning the presented content; that the material is potentially significant and that the student has the necessary subsunsors to learn the content. Subsunsors is a concept created by Ausubel to represent the prior knowledge that the student has on a given content and that is present in his cognitive structures.

In spite of completely inefficient appearance in terms of learning, the mechanical learning has an important paper inside the theory of the meaningful learning, which is of building subsunsors when these do not exist.

To this mechanical learning is necessary the use of organizers ordinary. We can understand as a prior organizer a material, film, exhibition, discussion or any other form of material that could serve like outline of initial moorings for subsequent introduction of content that really is the object of the meaningful learning. It is a fact that a prior organizer cannot be in the same level of abstraction of the specific material of the learning. Must be in a level of abstraction and complexity more superficial, more generalist.

In order to understand reasonably how the process of assimilation takes place during the meaningful learning, is it possible use the scheme presented by Moreira (2006):

This can be summarized and expressed by the next equation:

The concept $a \rightarrow a'$ whenever in contact with its correspondent subsunor A , what also becomes A' , so $a \cdot A \rightarrow a' \cdot A'$.

In this way, tests of checking that confront the answer of the student and compare with the answer of the teacher are advised, because they just look to test the capacity of memorization of the apprentice in the particular concepts and not the understanding of the most general concepts that are formed in its cognitive structures.

3. Concept maps

The concept maps are a form of representation of the knowledge created by Joseph Novak, from the theory of the meaningful learning of Ausubel, to represent graphically the present knowledge in the cognitive structures of the individual.

Novak developed this tool from present concepts in the theory of the meaningful learning of David Ausubel. The theory suggests that the knowledge gets organized in the cognitive structures of the individual from connections between concepts, concepts these acquired during the interaction between the individual and the object of study. The concepts connected one to others, are structured in the hierarchical form where the most general concepts subordinate the most specific or particular.

An interesting aspect on the concept maps is its means of use in teaching practice. According to Moreira (1997) concept maps can be used as:

- ✓ Organizers of content in courses;
- ✓ Structuring of one unity of teaching for a class, showing relations between the involved concepts; Planning of curriculum;
- ✓ Instrument of evaluation of the learning.

In this work, were opted to use concept maps of three of these manners: structuring of contents, structuring of the concepts in an expositive class and instrument of evaluation of the learning of dynamic evolutive form.

At present, the research on the concept maps is developed in several points of the world, but his creator, Joseph Novak, and collaborators keep on developing other types of applications and improvements of the concept maps in the IHMC (Institute for Human and Machine Cognition), on supervision of Novak and collaboration of Alberto Cañas, creator of the Cmap Tools, a software that helps in the construction of concept maps. The software open to question is used in this work to produce the concept maps presented.

In the Figure 1 is presented a concept map on the relations between the principal concepts of the theory of the meaningful learning. The meaningful learning was used like theory of the learning that served like base for the development of the concept maps and here they are used to explain it

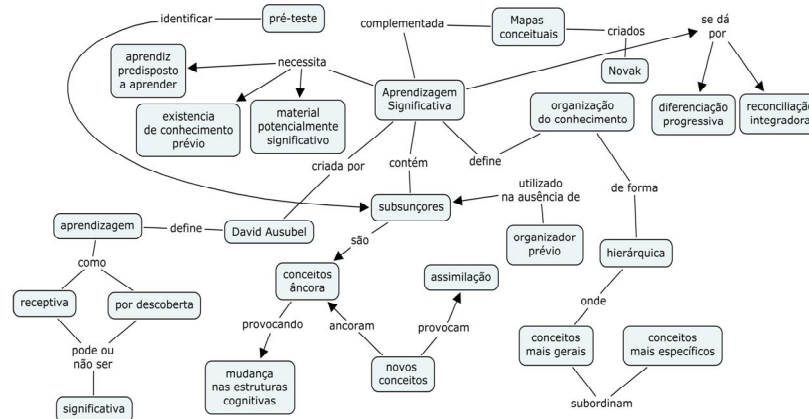


Figure 1. Concept map of the meaningful learning theory.

In the next section, is presented the characterization of the pedagogic-educational experiment in function of the theoretical presuppositions established.

4. The Characterization of the experiment

From the theories of the meaningful learning and of the mediator evaluation , a pedagogic-educational model was conceived for the practice in classroom with the students of the discipline of advanced control of the course of bachelor's degree in engineering of control and automation of the Federal Institute From North Part Of the state of Rio de Janeiro - IFF.

The objective of this model is to outline the new plan of class of the discipline from the ferramental theoretic presented, of the programmatical content of the discipline, and the inclusion of the proper instruments of collection of data. These instruments appear like mechanisms of investigation of the meaningful learning.

The new plan of class is developed for the attendance of the cognitive evolution of the student along the school period.

The field of application of the model consists by the students of the course of bachelor's degree in engineering of control and automation.

During the school semester the discipline of advanced control has a programmatical content to be worked by the students. This content was adapted for a new proposal of class including the instruments and following the ferramental theoretic used.

In the Figure 2 the stages of the process of teaching-learning that converge for the pedagogic-educational model are introduced.

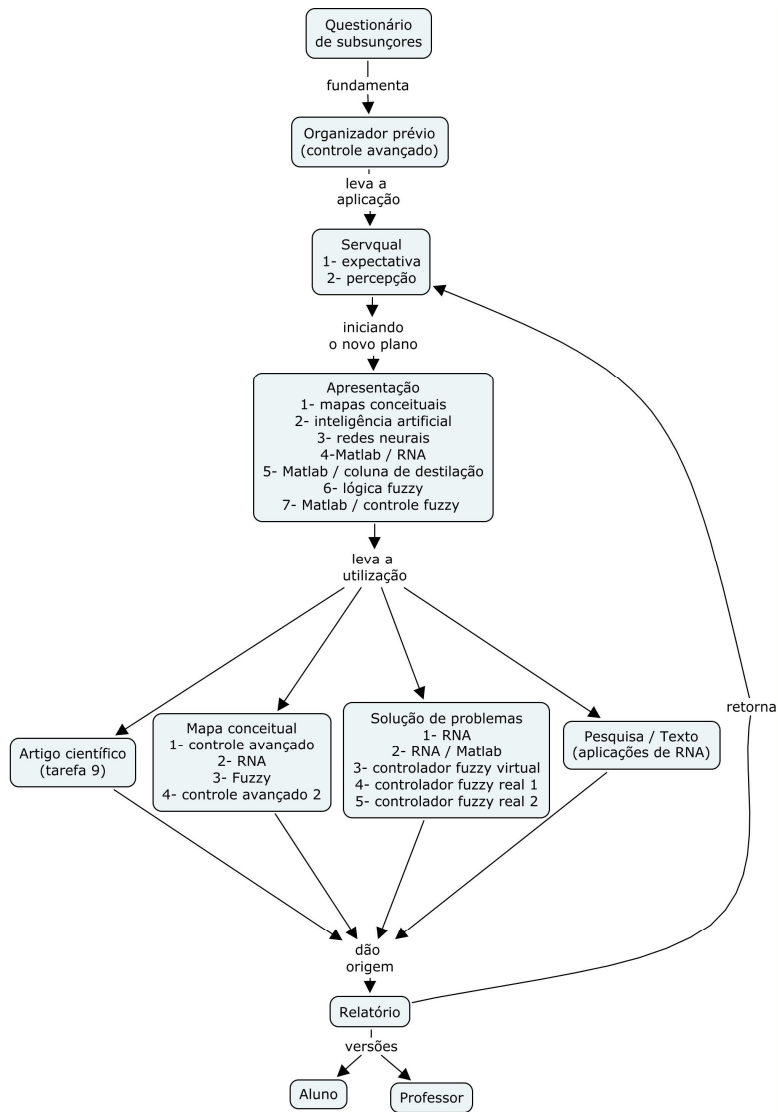


Figure 2. Concept map of the new plan of class.

The signs of the meaningful learning will be checked in the registers of the students through the reports and principally, in the concept maps built, as well as the process of solution of problems not predicted in the expositive classrooms that it is going to allow the visualization of the capacity of these students in generalizing the concepts and acquired skills and transpose them for new situations demonstrating understanding.

5. Results

The concept maps show the dynamic evolution in terms of cognitive structuring of the individual, operating on concepts of nets of concepts. Four individuals were selected by chance to have their concept maps presented.

The subjects proposed for the construction of the concept maps are relative to the curriculum of the discipline of advanced control in the course of engineering of control and automation, among them, neural artificial nets, logic fuzzy, identification of systems, control fuzzy, etc. In the

Figures 3, 4 and 5 are introduced the concept maps elaborated by the students during the pedagogic-educational experiment, these maps are presented from the left to the right, respectively from the most ancient to the most current thing.

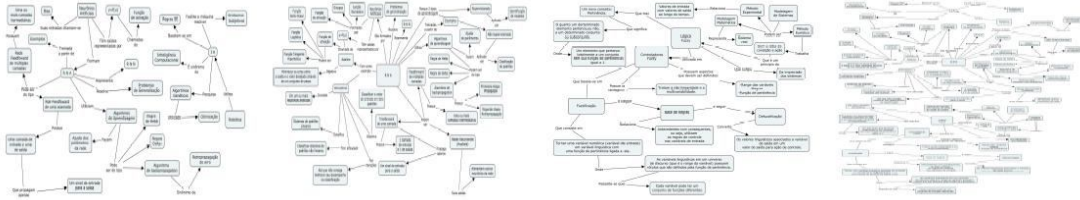


Figure 3. Concept maps of the student 1.

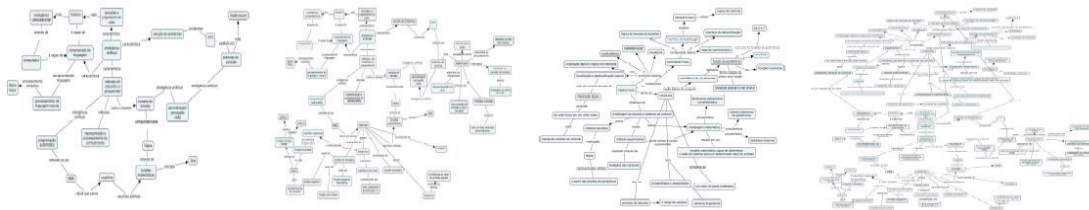


Figure 4. Concept maps of the student 2.

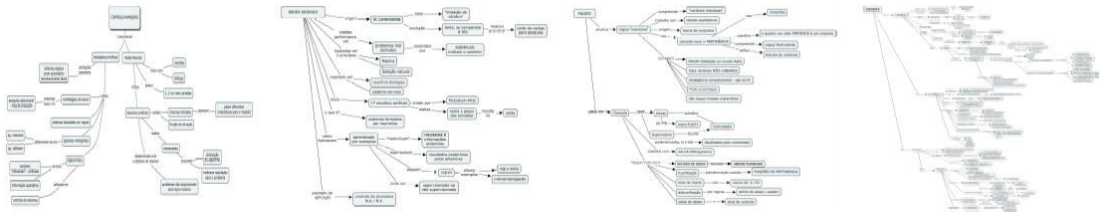


Figure 5. Concept maps of the student 3.

6. Considerations

From an existent gap in the process of teaching-learning of advanced control in courses of engineering of control and automation, this study proposed a solution based on theoretical presuppositions for the checking of the learning, providing the above-mentioned gap.

The results obtained and presented in the form of dynamic evolution of the concept maps can be seen as an extract of the cognitive organization of the investigated students, since they are based on the form like the concepts are structured and represented by the students. The hierarchization and branching are a tendency, but cross relations are also built.

The increase in the number of concepts of the maps shows up a great assimilation of the concepts supplied by the different objects of study understanding that the students had the necessary subsensors for the present content in the curriculum of the discipline. From these evidences, we can say that there was, in the investigated students, the demonstration of the meaningful learning, providing connections not arbitrary and significant in the net of concepts of the individuals.

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