MEANINGFUL LEARNING AND CONCEPT MAPS TO TEACH ELECTRICAL MACHINES FOR ADULTS

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ABSTRACT

This paper presents the use of concept maps as a tool for teaching and learning Electrical Machines for adults. This experience is based on the Theory of Meaningful Learning. An experiment was conducted in a classroom where adult students could produce concept maps according to the subjects studied. Reviews and evaluations were done to complete the work, highlighting its advantages in the learning process.

Key Words: Meaningful Learning, concept maps, teaching adults, electrical machines.

INTRODUCTION

With the advent of computer new learning spaces begin to be planned and built, no longer restricted to the perimeter where there is a closed and traditional relationship between teachers and students. Informatics allows rethink more dynamic and new approaches to the universe of knowledge working, creating new forms of learning and communication, encouraging the active participation of students in the educational process, urging them to see the world from a more critical, with the teacher as guiding this process. As stated by Leite et al., therefore, the construction of knowledge can and should be mediated by resources more enjoyable and stimulating (Leite et al., 2010, p.11).

Having your favor application versatility and adaptability in the application to various activities, information can promote curriculum integration, the breaking down of barriers between disciplines and between different cultures, enriching the education of students and contributing to raise the cultural and technological of learners. Moreover, according to Leite et al., digital technologies are increasingly, as mediating tools in teaching and learning (Leite et al., 2010, p.2).

In this context, the computer can be expected to contribute positively to accelerate the cognitive and intellectual development of the student, especially as this relates to the development and formal logical reasoning, the ability to think with rigor and systematicity, the ability to invent or find solutions for problems (Costa, 1998). You can also enable the student to develop their ability to learn to learn, stimulating autonomy - which is based on learning by doing - experimenting and creating. This is now a priority of the school, using this new technology, this process can become richer and more enjoyable (Coll, 2000). Accordingly, to the words of Leite et al., Information and Communication allow the organization of more flexible curriculum, in form that it been adapted to individual learning styles, and to promote greater academic autonomy and professional (Leite et al., 2010, p. 3). Figure 1 shows a concept map about how computing resources can be used in educational activities.
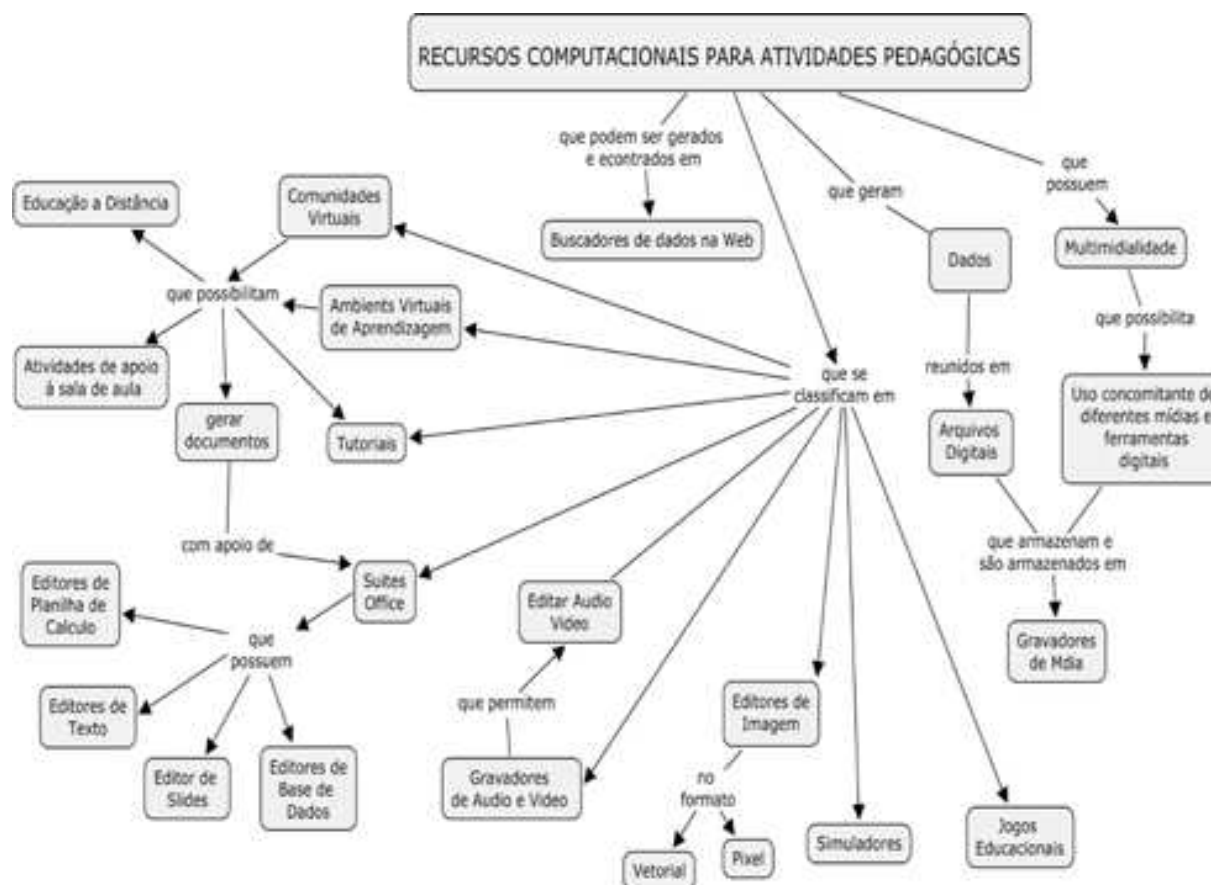
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Figure 1: How the computing resources can be used in educational activities (Albuquerque et al.)

This work presents the use of concept maps as a tool to teach Electrical Machines in a class of adults. The objective was to provide teachers with new potentially meaningful situations on teaching-learning of Electrical Machines using concept maps.

THE PROEJA

Considering that in Brazil there are a lot of people who left the school before the right time, the government is starting to minimize this problem with some politics of including these person in educational system again. By the Decree 5.478/05 which was replaced by Decree 5.840/06 made mandatory the implementation and expansion of the number of vacancies in the network of Federal Institutions of Professional Education for the sport PROEJA (National Integration of the Vocational Education and basic education in d mode and Education for Young people and Adults) (Leite and Franco, 2011).

The PROEJA, offering integrated technical vocational training in high school level in the form of education for young people and adults, absorbs students with varying degrees of difficulty of assimilating the content, students who have interrupted their studies and now want to resume it, in others words, features that need to be taken into consideration when establishing a planning. Thus, in the words of Leite et al., PROEJA faces its own problems and seek to solve them critically and creatively. (Leite et al., 2010, p. 02).

Computer resources are well observed by Albuquerque et al. (2009). According to them, given the demands of society, globalized character and networked, the proceeds with the development of IT have a meaningful contribution to the training and qualification of students entered in the National Program for the Integration of Professional Education with basic education in mode of Young and Adults Education (PROEJA).

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In this paper, the concept maps were used for the enrichment of the student study, allowing a better understanding of the contents studied.

MEANINGFUL LEARNING AND THIS WORK

This educational proposal is based on the Theory of Meaningful Learning David Ausubel. Meaningful learning is a process by which a new information relates to an important aspect of the knowledge structure of the individual (Moreira and Masini, 2001).

Concept maps are only diagrams indicating relationships between concepts or between words we use to represent concepts (Moreira, 1997).

This work intends from existing concepts in the cognitive structure of the student in Electrical, concepts such as electrical current and voltage, the student uses them as subsumers in order to underpin the new concepts to be learned, as the interaction between magnetic fields, these concepts are fundamental to understanding the functioning of Electrical Machines. According to Moreira (2006, p. 15) the subsumers are a concept, an idea, a proposition already existing cognitive structure, able to serve as 'anchor' the new information so that it acquires thus meaningful to the individual (i.e., it has able to assign meaning to this information). In this respect the concepts previously "anchored" in the cognitive structure of the learner, such as voltage and current, act as subsumers, so that new information is acquired by the learner. As new information, understand the concepts needed for the teaching of Electrical Machines.

According to Moreira (2006, p. 13), the most important idea in Ausubel's theory can be summarized in the following proposition Ausubel's own, the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly (Ausubel et al*.,* 1980, p. viii).

According to Moreira (2006), Ausubel is referring to the cognitive structure of the learner. It takes the content to be learned meaningfully.

Also, when Ausubel refers to "what the learner already knows" for learning to occur of new information, it is referring to specific aspects of cognitive structure.

Still according to Moreira (2006, p. 14), ascertain would be discover the pre-existing structure, concepts that already exist in the mind of the individual, his organization and their interrelationships; doing a "mapping" of cognitive structure, which is also something difficult to accomplish. This information serves as a basis for that is the planned use of concept maps as a teaching resource (Silveira, 2008, p. 95).

In Ausubel's proposition, "teach him accordingly", Moreira (2006) states that it means education basing on what the learner already knows, and identify it is not an easy task.

This work intends from existing concepts in the cognitive structure of the student of Electrical Engineering, the student uses them as subsumers in order to underpin the new concepts to be learned.

In this aspect concepts previously "anchored" at the student cognitive structures, act as subsumers, so that new information is acquired by the learner. As new information, understand the concepts needed for the teaching of Electrical Machines. As teaching Electrical Machines occurs in the second year of the Technical Course of Electricity and the student already has the concepts of current, voltage and magnetism well-founded, serving thus as subsumers to new learning. Ausubel says:

The essence of the meaningful learning process is that symbolically expressed ideas are related in a nonarbitrary and substantive (nonverbatim) fashion to watch the learner already knows, namely, to some existing relevant aspect of his structure of knowledge (AUSUBEL, 1968, p. 331).

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Therefore, it is important that students relate the concepts in new concepts with pre existing in their cognitive structure. In this case, such concepts are concepts grounded in the disciplines of low voltage electrical installations. Also, according to Moreira, one of the conditions to the occurrence of meaningful learning is that the material to be learned is relatable to the cognitive structure of the learner, in the way not arbitrary (Moreira, 2006, p. 19). Therefore, the Theory of Meaningful Learning will be of great value and will be used as a theoretical foundation in this work.

CONCEPT MAPS

Concept Maps are closely linked to Meaningful Learning Theory proposed by Ausubel. However, Ausubel never addressed concept maps in his theory. This is a technique developed by Joseph Novak and his colleagues at Cornell University (USA) (Moreira, 2010, p.17). Therefore, the concept maps were developed by Joseph Novak as a constructivist tool to support Meaningful Learning of Ausubel. Diagrams are used to represent, describe, organize, communicate concepts and the relationships between them. The concepts are the *nodes* (crosslinks) of the map and relations are the *links*. Generally, concepts are nouns and relationships are represented by verbal expressions. Figure 2 illustrates what is a concept map.

Concept maps can be used as an evaluation tool of learning, study strategy, content presentation, learning resource, among others. Concept maps may be used in obtaining evidence of meaningful learning, namely the evaluation of learning (Moreira, 2010, p. 22).
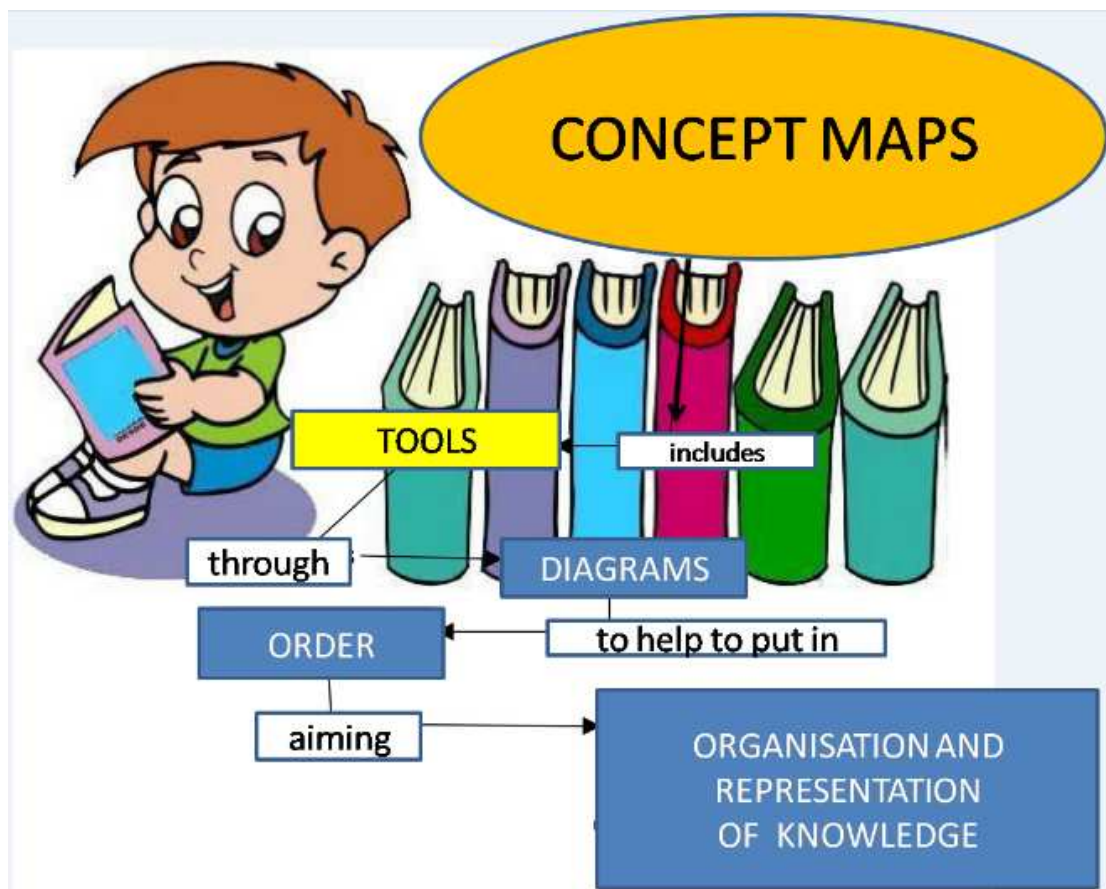

Figure 2: Definition of concept maps (adapted from: http://yohabloespaol.blogspot.com.br/2011/05/mapa-conceitual-sobre-cultura-flamenca_20.html

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According to Carvalho et al. (2010, p. 8), the evidence of meaningful learning will be checked in the records of the students by reports and especially in concept maps constructed. But be careful, because, like concept maps have meanings personal, some maps are very poor and demonstrate that there was no understanding of the desired content.

EXPERIMENT CONDUCTED IN THE CLASSROOM: CONCEPT MAPS CONSTRUCTED BY STUDENTS

This experiment was carried out using the tool CMap Tools which is free and can be downloaded on: http://cmap.ihmc.us/download/.

This experiment was conducted in a class that was studying the discipline Electrical Machines, night shift, module IV, PROEJA, Technical Course of Electricity at the Institute Federal Fluminense in Campos dos Goytacazes, state of Rio de Janeiro, Brazil. As the class was already in Module IV, had prior knowledge of the concepts needed as subsumers in the experiment. How Silveira says, recognition of prior skills is important in order to identify pre-existing subsumers in cognitive structure of the students (Silveira, 2008, p. 95).

The class had a total of eleven students aged 18-45 years, nine men and two women. The experiment was conducted at the first semester of 2011. We carried out a study on "Step Motors". Activities in the classroom were developed by lectures with handouts on their issues to be worked out. According to Moreira, it is possible to draw up a concept map for a single class for a unit of study for a course or even for a complete educational program (Moreira, 2010, p .16). Therefore, the end of each class the students were asked to jointly do a concept map on the subjects studied. The concept map on "Stepper Motors" is illustrated in Figure 3.
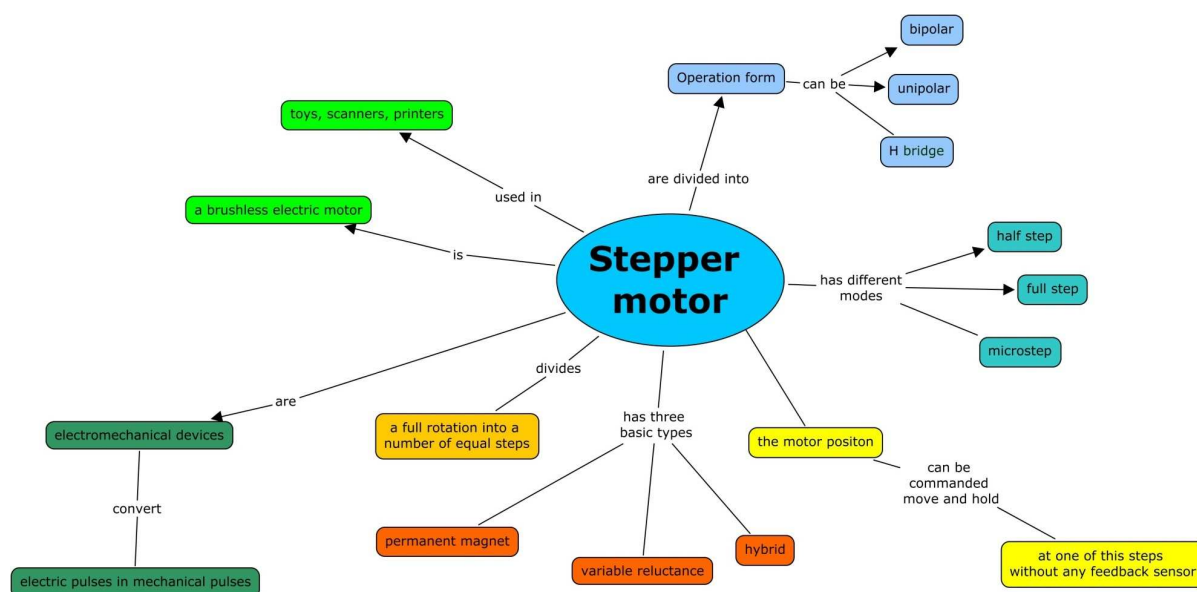

Figure 3: Concept map on "Stepper Motor" performed by students (Students at the classroom)

In the construction of the maps is a fundamental constant observation of the teacher, because, according to Silveira, the big challenge for the teacher is to help the student to use, consciously and productive, the potential of thinking (Silveira, 2008, p. 86).

At the end of the realization of the map, the students were asked to explain the same to all colleagues, since, according to Moreira, concept maps should be explained by those who do them. So, explain it to the person externalizes the meanings (Moreira, 2010, p. 15). At this time the students were able to present all material learned demonstrating that the making of the map facilitated the learning. In the words of Silveira, concept maps are different instruments that must be evaluated, especially qualitatively, in order to obtain evidence of meaningful learning (Silveira, 2008, p.87).

The maps prepared by students and later in the explanation made by them at the classroom, was evident the evolution of the students on the issues studied, making possible to observe evidence of meaningful learning. Noticed on the maps that students can do connections between the concepts studied, demonstrating a good knowledge of the subjects proposed.

FINDINGS

After the experiment, the students answered a questionnaire and the main results are described below.

Importantly, all stated that, while they were constructing the concept map, they could realize what were their difficulties in relation to the content studied and also considered it important to discuss with colleagues the subject studied during the making of the map.

All students said they considered easy to use the tool concept map and all the students said they had a broader view of the subject studied in the classroom.

Questions were asked in which students could freely respond to questions. Below are highlighted the most relevant answers.

A) "There are benefits to the student because it helps to organize the content studied." ... "I think there should be more widespread in educational institutions."
B) "You can interact more with the matter."
C) "Should be used more often."
D) "I thought cool. I would like to take more classes using these materials. "
E) "It is easy to learn, well organized. Good for organizing the contents. "
F) "Illustrates the best content studied. Great software for teaching. I realized that is very easy to learn the subject".

DISCUSSION

According to the questionnaire responses, the students had no difficulty to build the concept maps. Also, they have a more comprehensive view of the content studied. Together construction of concept maps enabled the interaction between students, and bringing the possibility of inclusion and appreciation of the tacit knowledge of each student. The students were succeeded in better organize the contents studied. Was important that the map was made exclusively by students, becoming a great authoring tool. Another aspect observed was the creativity of the students at the time of construction of the maps. The students felt very motivated, both at the time of creation, and in time the explanation of the maps, allowing a good possibility of evaluation by the teacher, the content studied. Another aspect to be addressed is the economy, because it is a free software, which only needs a computer. With the analysis of the concept map the teacher can have a great information about how learning is being developed.

CONCLUSION

It is important to recognize the subsumers pre-existing cognitive structure of the students so that they can plan the best use of concept maps as a teaching resource.

The teacher has to make a good planning so that activities in the classroom are developed efficiently.

Concept maps were presented as a great resource for teaching and learning.

Moreover, consider important to observe that this work applied the concept maps tool only with adults and young people that have a lot of living experience to put on the maps together the contents.

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