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CONCEPT MAP AS A TOOL IN THE TEACHING-LEARNING PROCESS OS ELECTROSTATIC

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ABSTRACT

This paper presents a proposal for the use of concept maps as a teaching and learning tool in the discipline of electrostatic in a Course of Technology. The experiment is based on the Theory of Meaningful Learning. A study was conducted in a classroom where students reviewed the subject in a concept map built specifically for a review of concepts, as seen in the classroom. The research uses concept map as a cognitive tool, supporting the computing and demonstrates by means of a comparison test, the initial knowledge and after presenting the conceptual map of electrostatics, the values obtained from the same test.

Key Words: Teaching-learning, Electrostatics, Concept map.

INTRODUCTION

Although physics has been known since antiquity, mainly electrical phenomena, it is discussed today how to teach students. In general, the curriculum starts from the Newtonian physics: mechanics, followed by thermodynamics, optics, waves and only at the end of the courses the students will study concepts of electrostatics and magnetism. In some courses this subjects are included as specific matters.

The process of teaching and learning Electrostatic, specific branch of physics, is necessary to understand Electromagnetism and involves magnetic fields and vectors, which are usually defined by totally mathematical approaches.

Necessarily the process of interaction between particles are described in various concepts relating forces, fields, energies, vectors, among other phenomena and magnitudes. Each step must be clear to be possible the

identification and to do the relations between concepts. So the students will be able to understand these concepts.

Martin e Solbes (2001) say that the student does not know the differences in interaction between particles and even don't know about induction fields. The authors say that what students know about electrostatic fields is not a scientific concept.

Martin e Solbes (2001) explain that students observe the phenomena without considering mass, charge and force e don't consider the interaction between particles. So, for example, they cannot distinguish field intensity and some teachers also are confused themselves. In this way, the students cannot understand important aspects and cannot associate the interaction between particles (MARTIN; SOLBES, 2001). In other words, it is not possible to observe a global view between concepts, their importance and the mathematics that is implicate.

According to Martin e Solbes (2001), the difficulty to promote a qualitative teaching about electric field is because the abstraction that the study demands. So, it is difficult to establish relations with day by day student's experiences as it occurs with the Newtonian physics. And the authors conclude that the didactic books show a lot of mistakes that promotes confusion in the teaching-learning process.

Gução et al. (2008) analyzed physics books in Brazil and related conceptual mistakes about history and chronology of the physics events: (I) at the first demonstration, the authors transcribe a mistake in formulation of the principle of conservation of energy, with confusing texts; (ii) at the second analysis the authors show a chronological mistake about electric phenomena; (III) at the third book, they found wrong assumptions; (IV) at the fourth didactic book there are mistakes about dates and researchers.

In this experiment, a concept map built by the teacher was used in a review class. There was a pretest and a post-test to verify the learning process.

This study intends to show the viability of Physics studies, specifically Electrostatics, which involves concepts and mathematics relations, using a cognitive tool. This cognitive tool is based in formulation of concepts with Informatics. In this process, teaching-learning becomes easier for students and teachers.

THE THEORY OF MEANINGFUL LEARNING

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 used to represent concepts (Moreira, 1997).

This work intends, from existing concepts in the cognitive structure of the student in Electrical, concepts such as atoms, electrons, neutrons, protons, the student uses them as subsumers in order to support the new concepts to be learned.

According to Moreira (2006: 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 atoms, electrons, neutrons, protons, act as subsumers, so that new information is acquired by the learner. As new information, understand the concepts needed.

According to Moreira (2006:13), 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. Check this and teach him accordingly (Ausubel et al., 1980: 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 (2006:14), check 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,: 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, they use 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. Ausubel says that the essence of the meaningful learning process is that symbolically expressed ideas are related in a no arbitrary and substantive way to know what the learner already knows, namely, some existing relevant aspect of his structure of knowledge (Ausubel, 1968: 331). Therefore, it is important that students relate the concepts in new concepts with pre existing in their cognitive structure. 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: 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: 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: 22). Figure 1 shows a concept map, including the software installation and building maps.

Concept maps can be used as learning assessment, study strategy, to teach the subject, among others. Concept maps can be used to verify to get evidences of meaningful learning, i.e., in the assessment of learning (MOREIRA, 2010, p. 22). But, it must be careful because some maps are too poor and it shows that learning did not occur as it should be.

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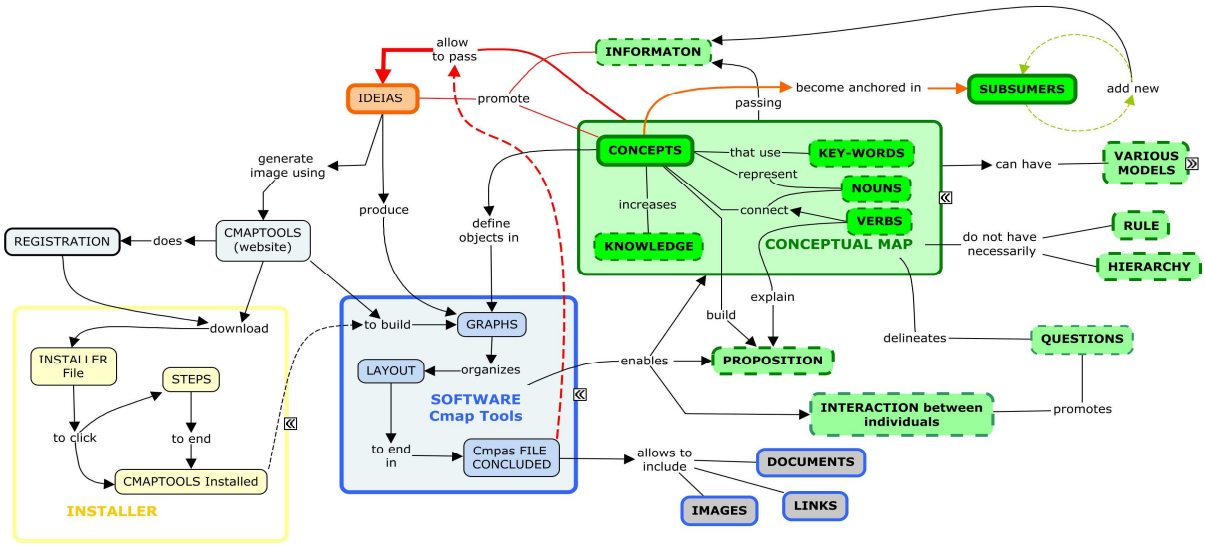

Fig. 1: Concept map definition

METHODOLOGY

A review class was done using an Electrostatics concept map. The experiment was realized with six undergraduate students of the first year of Telecommunications course in a Federal Institute of Brazil in July 2013. This experiment lasted for 3 hours and was done one week before the test.

First the students answered a pretest with five questions to verify their knowledge level. Second, the teacher did the review using the concept map built by the teacher. At the end, the students answered a post-test (with the same questions) to verify the new knowledge level. The concept map used at this experiment is shown at figure 2. This map was built with *CmapTools*.

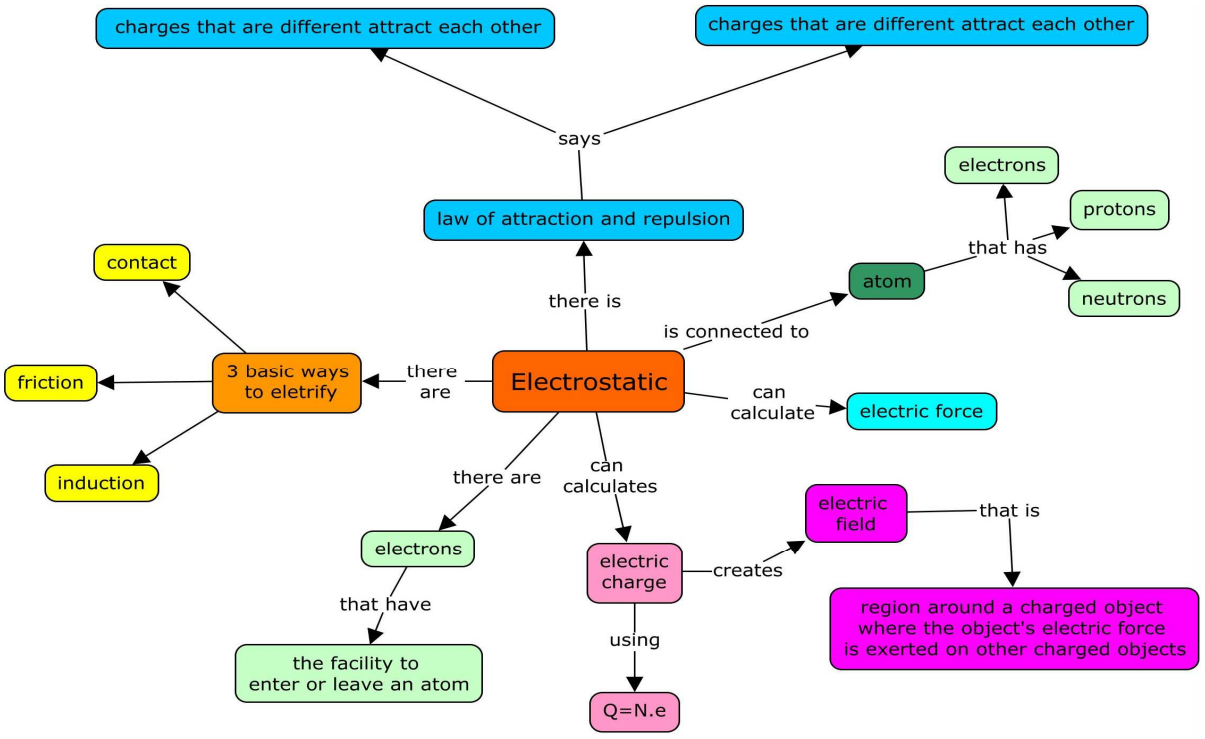

Fig. 2: Concept map used in this experiment

This concept map was also available to students after this with this experiment. So they were able to study using this one in the future.

RESULTS AND DISCUSSION

After the review, the same test was applied and the results are:

Frame 1: Hits

Atividade	How many hits					
	1	2	3	4	5	Total
Pretest	1	1	1	2	1	6
Post-test	3	2	3	3	6	17

In the pretest there were less hits then in the post-test. The post-test was realized after the explanation with the concept map (figure 3)

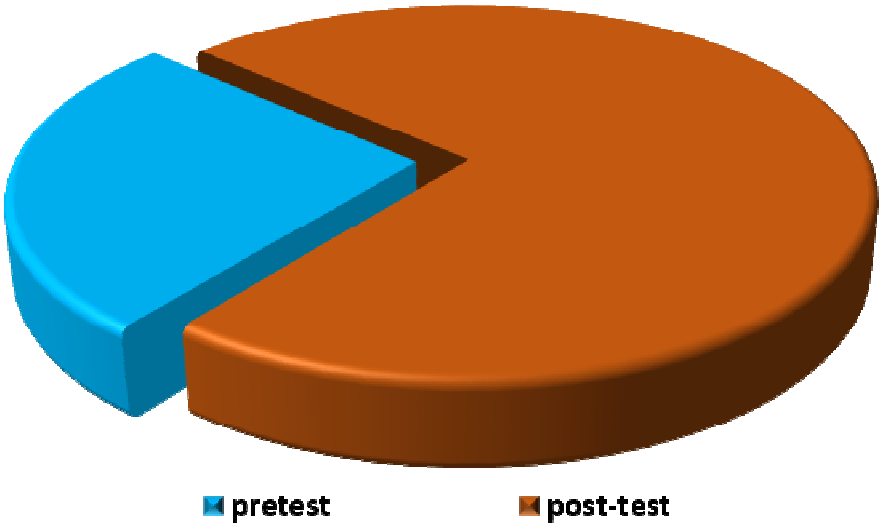

Fig. 3: Graphic comparing hits

In a concept map is possible to show all information at the same time, interfering and forming new concepts. Figure 2 shows all the subject of the class in one map.

Teacher and students can use the map as reference to build knowledge, advancing in their own knowledge again, as shown in figure 4.

Fig. 4: Graphic comparing pretest and post-test

In teaching-learning point of view, is important to recognize the subsummers in students. In this way, the teacher will be able to plan the classes in a best way.

Students Highlights

To understand the teaching-learning process, at the end, a questionnaire with six questions was applied with the students. The questions were: 1ª "Did you study electrostatic?"; 2ª "Did you learn the concepts?"; 3ª "Do you think that is easy to learn the concepts?"; 4ª "Do you think that is easier to visualize the subjects?" 5ª "Do you feel more prepared about the concepts that you learned after studying with concept map?"; 6ª "Do you think that will be easier to study with the concept map?"

The student's answers are as follows (frame 2):

Frame 2: Student's answers

	1ª Did you study electrostatic?	2ª Did you learn the concepts?	Do you think that is easy to learn the concepts?	4ª Do you think that is easier to visualize the subjects?	5ª Do you feel more prepared about the concepts that you learned after studying with concept map?	6ª Do you think that will be easier to study with the concept map?	**Total**
Strongly agree	2	1	2	2	1	2	**10**
Agree	4	5	4	3	5	3	**24**
Neither	-	-	-	1	-	1	2
Disagree	-	-	-	-	-	-	-
Strongly disagree	-	-	-	-	-	-	-
Total of students	6	6	6	6	6	6	

From frame 2 the graphics 5A, 5B and 5C were extracted (figure 5).

Fig. 5A

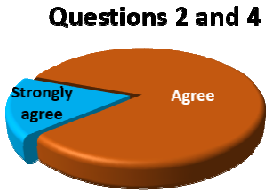

Fig. 5B

Fig. 5C

Fig. 5: Graphics (questions 1 to 6).

The graphic on figure 6 is about the total.

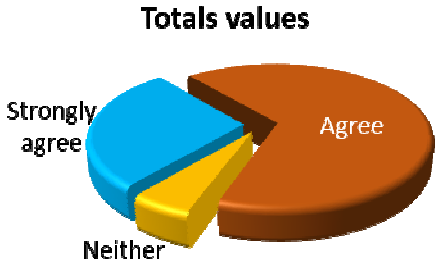

Fig. 6: Total (from frame 6)

CONCLUSION

In this experiment, a concept map about Electrostatic was built by the teacher and used in a review class. Before using it, was applied a questionnaire. After the review, the same questionnaire was applied. After the experiment, the students increased the hits, showing that the concept map is an excellent tool to review classes.

The questionnaire answered by the students shows that they mostly agree that is good to study with concept maps.

Concept maps
Na análise pontuada pelos alunos sobre a aprendizagem significativa com mapa conceitual, observou-se uma adesão favorável, bem como também o processo valorizado do ensino-aprendizagem da disciplina.

Concept maps help the process of meaningful and collaborative teaching.

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