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TRAINING STUDENTS AT A DISTANCE TO CREATE CONCEPT MAPS

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Abstract. Since Novak & Gowin (1984) published *Learning to Learn*, concept maps (CM) have become increasingly popular as an educational tool. Even if the literature agrees that students need to be trained on how to create CM, we have found that researchers rarely describe the conditions under which students need to be trained - whether it was in a classroom setting or at a distance. This article presents the results of an analysis of the training needs of 21 students who built CM in a distance education course.

1 Background

The work of Novak & Gowin (1984), *Learning to Learn*, propagated the use of concept maps (CM) within education. More recently, concept mapping activities have been proposed to students in a distance learning context (Basque, Pudelko & Legros, 2003; De Simone, Schmid & McEven, 2001).

Many studies have been conducted on the effects of using and constructing CM on student learning (Horton *et al*., 1993; Nesbitt & Adesope, submitted); yet we know very little on how to train learners to concept map (Patry, 2003; Basque et Pudelko, 2004), whether it is face-to-face or at a distance. Not only is there little research that addresses this subject specifically, but in the research on the creation of educational CM, the participant's training conditions are not fully described. However, a number of authors have highlighted the importance of good training on the construction of CM (Shavelson, Lang & Lewin, 1994; Novak & Gowin, 1984; White & Gunstone, 1992).

Our analysis of the seldom provided information on concept mapping training strategies by researchers led to several conclusions. First of all, the duration of the training offered to participants varies from a few minutes to several hours. Second, training was completed within one session or experienced several times over a long period of time. Finally, the training materials used varied. These variations could explain some of the variations found on the effect on learning in the studies (Patry 1998).

Our research aims to develop a training module on concept mapping for students registered in a distance education course. To achieve this goal and facilitate the design of the module, we conducted a needs analysis with students having to construct concept maps in some distance education courses and with their instructors . Some of the students had to use a concept mapping software integrating a typology of knowledge objects and a typology of links. The needs analysis aimed to identify: (1) the difficulties students perceive while creating CM; (2) the difficulties experienced by students with the representation language used in the software; (3) the difficulties students at a distance can encounter when using the CM software; and (4) the possible solutions to fulfill training needs.

2 Methodology

Twenty-one (21) students participated in this study. These students were registered in a graduate program at the Télé-université, a francophone university dedicated to distance education. Thirteen (13) students constructed a CMap in a course on cognitive sciences and learning, while eight (8) built three CMaps in a course on instructional design. We also interrogated five tutors[1] who supervised the courses. Additionally, we questioned an experienced trainer who teaches knowledge modeling technique in organizations in a face-to-face mode.

The students from both courses were surveyed using a questionnaire that was sent to them by email. Data from the five tutors and the trainer was collected using semi-structured interviews.. Students, tutors, and the trainer provided information on training documents accessible to students in the courses, which guide them in the process of creating CM and developing knowledge modeling skills.

The questionnaire sent to students also contained questions on the use of the CM software proposed in the course and its typologies. The MOT software developed by the LICEF Research Center at the Télé-université

[1] The tutors are not the designers of the courses. Their task is to guide the students in the predefined learning activities and to mark their work.

(Paquette, 2002) was mandatory only in the course on instructional design but many students from the other course also chose to use it. In the MOT software, the user is asked to distinguish between four types of knowledge and six types of links but he could also used the untyped knowledge or links, Knowledge objects are distinguished with different geometric shapes, and links are distinguished with letters which intersect the links between knowledge objects (*e.g.* C = Composition link). Syntax rules are specified within the software to minimize the possible choice of links between pairs of knowledge objects, according to their knowledge type.[2]

Finally, students were expected to state in the questionnaire whether they thought the CM was useful, to report difficulties they encountered during this process, and to suggest improvements to CM training.

3 Results and discussion

3.1 Difficulties in producing CM

The first difficulty the students had when constructing CM was that they did not see the ultimate goal of completing the activity. The students had difficulties visualizing the final product and the pertinence of the CM itself. One of the instructors mentioned that the students felt insecure about the final structure of the CM because it was to be evaluated and graded.

The students also had problems targeting the information and knowledge which were to be incorporated in the CM: "My main problem is that I have difficulties identifying and narrowing down which information should be included and which should be excluded." (Student). In addition to this comment, two of the tutors indicated that students had difficulties choosing the knowledge or concepts which were to be integrated in the maps. The trainer found that, in his experience, students have a tendency to include too much text in the nodes of the map. As a result, instructors must provide additional explanations to students about the information which is to be included in the map and its nodes. Platteaux (1999) confirms that the choice of concepts to represent in the CM is one of the main difficulties students encounter.

Once the information and knowledge to be incorporated in the network are chosen, the data indicates that students have difficulties with the linking proccess. One student admitted that the knowledge objects were not enough linked together in her CMs. Another student indicated that he questioned himself on the manner in which procedural knowledge and any sub-procedures were to be represented. A sample problem was presented by the student who wanted to represent a global method where the order in which the steps were taken, the references used, and the results of the activity was unspecified.

The other difficulties touched on organizing the concepts within the map. In support of this, a tutor mentioned that spatial organization of the objects in a map was a problem for students. The trainer supported this claim and stated that presenting ideas in graphical form can be difficult for some because they may have difficulties expressing what they have internalized. For example, the instructors highlighted the fact that students "build little by little without having a global understanding of the subject" and that "often students rely on assumptions that are unfounded". One of the tutors pointed out that there were often gaps between the students' intentions and what was actually represented in the CM.

3.2 Difficulties with the modeling language used to produce CM

When using MOT, students adopt three types of behaviors. A small proportion of students used the full features of the language proposed. Others decide to use the typed knowledge objects but untyped links with their own tags on them. Others, still, use the language until they encounter problems and abandon this method entirely.

Three different categories of difficulties apply in using the knowledge modeling language, which have been brought up by both students and tutors. The first relates to the typology of knowledge of the MOT language. The students have difficulties distinguishing between the concepts, procedures, principles, and facts. The differences between principles and procedures seem particularly difficult to make.

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[2] For more information on MOT : www.licef.teluq.uqam.ca

Students also experience difficulties with the typology of links in the MOT language. Specifically, the *Specialisation* and *Input/Output* links were mentioned by students and tutors. This inability to name or tag links is regularly cited by authors (Basque, Pudelko, & Legros, 2003; Novak & Gowin, 1984; Fisher, 1990). Faletti & Fisher (1996) found that links are more difficult to understand than the concepts because they can change based on the context in which the knowledge is used. As Loiselle & Rouleau (1991) point out, we can more easily determine the existence of a relation between two concepts than the nature of this relation.

Faletti & Fisher (1996) also believe that identifying the relation between concepts is the most difficult aspect of knowledge construction. For Fisher (1990), this difficulty is due to the fact that, normally, identifying relations is sufficient without having to name them. According to Pudelko, Basque, & Legros (2002), the necessity of analyzing and naming relations between concepts is the most difficult part of creating concept mapping but also the most instructional.

The third difficulty relates to the grammar of MOT. When the user attempts to link two objects without respecting the MOT syntax, the software automatically transforms the link into one that is "permitted". As mentioned by one of the instructors, this causes frustration on the student's part because they do not understand the syntax rules implemented in the sofware well enough.

Using a precise semantic language, such as the one for modelling object types, seems to hinder the link identification process instead of facilitating it. Proposing a limited number of universal links should facilitate the task but, as is demonstrated, students often do not grasp that the typed links provided are synonyms of the links they are attempting to use.

3.3 Difficulties in manipulating the software.

The students have little difficulty learning to use CM software like MOT. During their initial use of the software, students expressed that they were experiencing difficulties making basic manipulations, such as moving or erasing an object. According to the trainer, this problem could easily be solved using demos.

3.4 Possible solutions to fufill training needs

Students, tutors, and the trainer provided suggestions for the design of a training module on CM. One is to use much more practical exercises. Participants who were provided with training material that did not contain practical exercises suggested that these were needed but they should remain optional based on the needs of individuals. The students in the instructional design course who were given electronic files where only a few exercises were provided, mentioned that they did not want to complete all exercises because they did not believe all of them were necessary for their own specific needs. This supports statements made by Novak & Gowin (1984) and Ruiz-Primo (2000) who believe that an extensive period of practical exercises is important. Furthermore, it is obvious from the comments collected that participants should receive feedback following theses practical exercises and that this feedback be provided by either an instructor (Wandersee, 1990) or by a computer (Chang et al., 2001). We think that a training module for CM construction must be composed of small training units, each with an increasing level of difficulty. We suggest the use of different methods of scaffolding similar to those used by Ruiz-Primo (2000) and Patry (1998). The exercises should concentrate on the development of CM construction skills and the discernment of knowledge and links types.

A second possibility comes in the form of multimedia. The construction of CMaps is a dynamic and non-linear process and the final product is difficult to predict. The students, the tutors, and the trainer suggested, over and over again, that multimedia should be used to demonstrate the dynamic process encountered during construction with the MOT software considering the distance education context. For example, audio instructions associated with visual presentations of the user's various object manipulations on screen and their results would facilitate learning. Modelling would be encouraged by using verbal directions concurrent with visual display of actions in the interface. Using multimedia in this way would also address the need for more practical examples.

4 Conclusion

Our analysis of student's training needs for creating CM in a distance education context confirms that this is an activity that requires a certain amount of training. Learning to use a CM software using a specific modeling language adds to the complexity of graphically representing knowledge.

The needs analysis pinpointed the difficulties experienced by students when creating the CM, when using the construction language, and when using the CM software. It is noteworthy that participants did not identify difficulties that could be considered in relation to distance learning situations. However. the solutions presented by the participants, with aims of minimizing the difficulties identified, gives us some hints on how to design the CM training module and we plan to use multimedia technologies to adapt it to distance learning.

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