

## MERGEMAPS – A COMPUTATIONAL TOOL FOR MERGING OF CONCEPT MAPS

*Geraldo A. Vassoler, Wagner de A. Perin & Davidson Cury, Federal University of Espirito Santo, Brazil  
 Email: gevasso@gmail.com*

**Abstract.** Concept maps are graphical representations of knowledge about a given domain often used in pedagogical approaches with the purpose of promoting meaningful learning. The research presented here discusses the importance of merging of concept maps and their implications in monitoring and evaluating the performance of groups learners. A computational solution capable of automatically perform the merging of maps is shown. A prototype was developed and is also presented.

**Keywords:** Concept maps, merging of maps.

### 1 Concept Maps and Meaningful Learning

Concept map is a graphical representation language of a given field of knowledge that "enables the redefinition of content, supporting thus focused educational practices for meaningful learning" [Kowata et al 2010]. As students construct knowledge, concept maps can be used to integrate, reconcile and distinguish concepts [Perin et al 2012].

This language is inspired by the so-called Theory of Meaningful Learning of Ausubel *et al* (1978). Concept maps have these theoretical assumptions by three main features: a) the concepts are arranged in a semi-hierarchical manner, where the most general subsume the more specific; b) concepts are identified by a pair of words that define "a perceived regularity in events or objects, or records of events or objects" [Novak & Gowin 1984]; and c) the relationship between two concepts are labeled in order to compose well defined propositions with clear meanings.

The mental processes involved in the practice of making and remaking concept maps are evidenced through the efforts involved in the discovery of new concepts or expanding the meanings of these concepts, thus giving rise to knowledge explicitly [Kowata et al 2010]. Figures 1 and 2 show examples of concept maps constructed by different students, which represent the same domain knowledge, namely: "What concept maps are?".

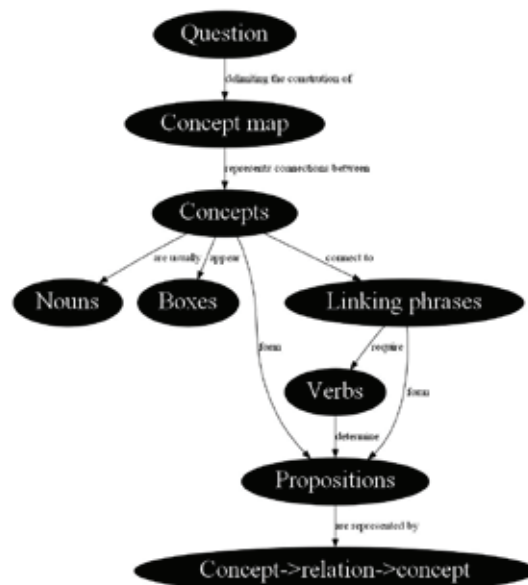


Figure 1: Concept map of student 1.

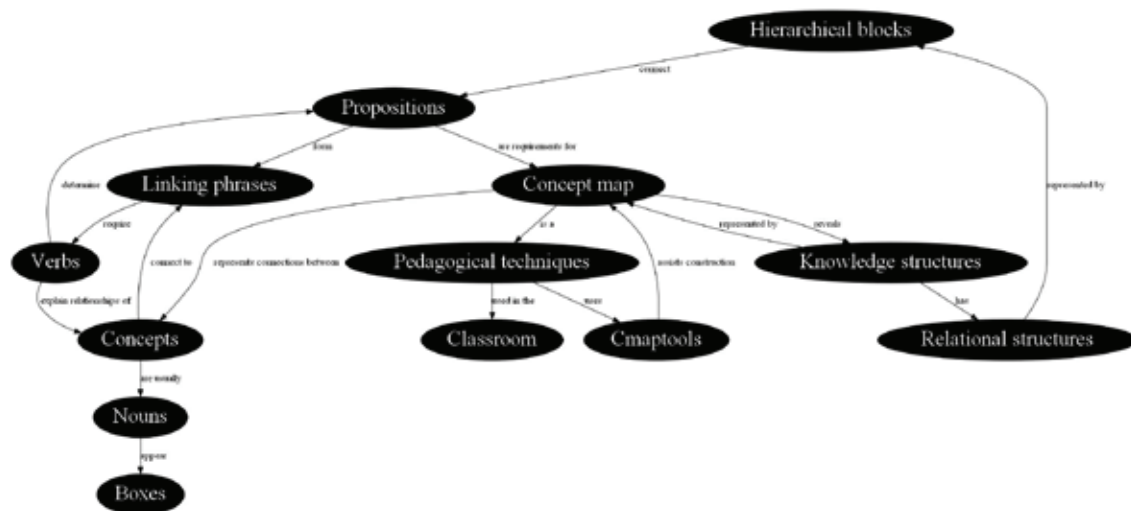


Figure 2: Concept map of student 2.

The strong adhesion of concept maps are with pedagogical approaches that aim to meaningful learning has led several researchers to enhance and create new techniques and tools, for example, support automatic or semi-automatic creation of concept maps [Kowata et al 2010]; use artificial intelligence to promote human interactions with concept maps through questions and answers [Perin et al 2012].

## 2 How and why merge concept maps?

The previous section made it clear that concept maps are graphical representations of knowledge of an individual, or a group of individuals, in a given domain. It happens that, except for cases in which concept maps are developed collaboratively, these representations are individualized and loaded with concepts and relations that embody the knowledge of the person who prepared it.

The information obtained by merging maps can be valuable for teaching, because these concepts and relationships that are repeated in different versions can be regarded as representations of the average knowledge of the class. This is one of the factors that make merging maps a meaningful service. The average knowledge of the class can point to the teacher, for example, to what degree is the general understanding of the class on the issues which are being worked in the classroom. It also allows to identify those concepts still not formed by students, indicating which concepts need to be further explored. Merging maps allows still getting a more accurate description of a particular field of knowledge. Different texts can be described by means of concept maps.

## 3 A proof of concept

In order to perform a proof of concept that makes possible to check at least some of the advantages of merging concept maps listed in the previous section, an experiment was conducted with two students of Master in Computer Science from an UFES. These students were asked to read the same article, entitled "Applications of Concept Maps as Metacognitive Tools in Education" [Gava et al 2003]. Each student should build its own concept map, limited by the scope of the research question: "what is a Concept Map?". Those maps are shown in Figures 1 and 2, presented in Section 1. After that, the merging was performed manually, which spent considerable time. As a result, a third map was obtained, called merged map, shown in Figure 3.

It can be seen by means of the orange highlighted concepts, the existence of a knowledge standard, or average knowledge, between these two students. Such information gives the teacher a sense of how students are formalizing the knowledge explored, demonstrating the degree of correspondence between them.

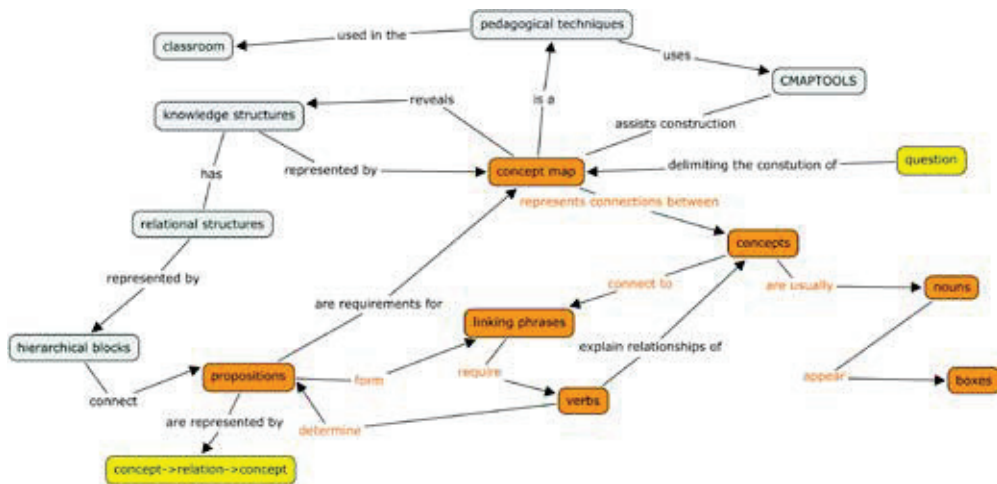


Figure 3: Concept Map generated by the fusion of Maps 1 and 2.

With this experiment it was concluded that the merging of concept maps can corroborate the work of teachers in collecting information about the progress of learning of all students in a given classroom. It is therefore justifiable the efforts to create computational mechanisms that automate the process of merging concept maps. The next section will present MergeMaps, a mechanism of merging concept maps.

#### 4 The MergeMaps

The *MergeMaps* is a service aimed merging maps and designed in order to extend the basic functionality of a services platform called CMPaaS. This service will consume the basic services provided by the platform, integrating them and composing a new tool for the Knowledge Portal.

As a tool, *MergeMaps* can be accessed through the Knowledge Portal, consuming authentication services, editing, managing and consulting maps of the CMPaaS repository. Figure 4 shows how the *MergeMaps* service is integrated with CMPaaS and the Knowledge Portal. The figure also shows that it is possible to infer that message exchanges between the portal and the platform might occur as well as between the platform internal services.

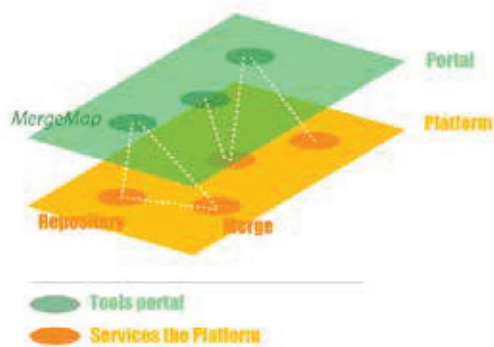


Figure 4: View of the integration of *MergeMaps* on CMPaaS.

##### 4.1. The merging maps process

The first action taken by the merging maps service is requesting of maps present in the repository that should be merged. Figure 5 shows an example of using two maps which are already selected for merging. Pressing the "merge" button merging service is triggered and will, quickly and transparently, make the procedure for merging the maps. This procedure is composed of the following steps: All concepts and relationships from both maps are decomposed; a new map is generated; all the concepts and relations of the first map are copied

to the new map; for each concept and relation of the second map is made a comparison with all the concepts in the generated map, if the concept or relation in question already exists in the new map, it is counted. It is then discarded. The concept / relation is then painted in a color that indicates its occurrence in both maps. It is then discarded in order to avoid redundancies, or if the concept or relation in question does not yet exist in the new map, it is added.

At the end of the merging process the result will be a new map containing all the concepts and relationships of the original maps. The concepts and relations synonyms are also marked. Figure 5 shows the result obtained by merging the maps of Figures 1 and 2.



**Figure 5:** The result of merging maps using *MergeMaps*.

As can be seen, the result obtained using *MergeMaps* (Figure 5) is similar to the result achieved with the manual process (Figure 3), what highlights the good functioning of the tool in its current state.

## 5 Conclusions

As discussed, the merging of concept maps can provide valuable information to teachers with regard to the learning process of a student, or a group. This paper presented the *MergeMaps*, a tool to facilitate the process of merging maps, enhancing the application of concept maps in various pedagogical approaches and promoting the monitoring and evaluation of knowledge construction. The expectation is that the community will soon be able to exploit this functionality and improve it, or even extend it, so as to provide, increasingly, quality services in support of teaching practices that promote meaningful learning.

## Referencies

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