

## LEARNING EVALUATION USING CONCEPT MAPS IN A COOPERATIVE ENVIRONMENT

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**Abstract.** The objective of this work is to offer a supporting environment to the accompaniment of cooperative activities for learning evaluation. Learners after having completed instructional activities will be involved in learning evaluation activities previously programmed in agreement with the instructional objectives. The teacher in this process acts as a coach or facilitator. Playing this role, the facilitator could propose challenges to the students and bring them for the learning process, being part of it. One of the objectives of learning evaluation is to verify if the student after having concluded the learning activities has reached to the instructional objectives. This study takes advantage of the current computational powerful resources offering a group of tools aiming at contributing to the educational area and turning easier the students' mental work in improving the performance in the knowledge construction process.

### 1 Introduction

The objective of this work is to present a Web-based supporting environment for managing cooperative activities for learning evaluation. In a distance-learning context, usual formal evaluation techniques, such as quizzes, tests, examinations, term papers, lab reports, and homework, are not always convenient when meaningful learning is the target. In this context, it is very useful that learners can reflect on what they are learning.

Concept mapping is a learning evaluation technique that helps to circumvent some difficulties in learning evaluation when in a distance context, such as difficulties in identifying misconceptions, right concepts, pertinent relationships among concepts, and inadequate relationships (Gaines & Shaw, 1995). Concept mapping helps externalize the learner's cognitive structure on the subject as concepts and propositions through concept maps. Thus concept mapping is considered a critical factor in improving learner achievement, since it facilitates the learner to reach meaningful learning (Novak & Gowin, 1984).

The proposed computer environment aims at the following: allowing the learning facilitator (possibly a teacher) establishing individual or cooperative evaluation activities about planned subjects; allowing the learners to engage in individual or cooperative evaluation activities and in dialogue with other group learners and with the facilitator. The Web-based supporting environment offers a cooperative concept map editor (CCME), a task scheduler and a chat mechanism, working with the client/server technology. The facilitator can define and schedule individual or cooperative learning evaluation activities through the task scheduler, besides assigning and defining small cooperative groups, and proposing guidelines and hints for the proposed activities.

This paper has the following organization. In Section 2 concept maps as a learning tool are presented. Section 3 discusses the use of concept maps as a learning evaluation tool. Section 4 introduces the proposed software environment as the learning evaluation tool. In Section 5 the environment architecture is shown. And finally in Section 6 the conclusion of the work is presented.

### 2 Concept Maps as a Learning Tool

Concept maps, developed in 1972 by Novak (1998), are graphic tools for the visual representation and knowledge structure's organization (Gaines & Shaw, 1995). Concept maps are learning evaluation techniques that help to eliminate some difficulties found in the learning evaluation in a distance context, such as in identifying misconceptions (Cañas & Ford, 2000; Cañas et al., 1999), the right concepts, important relationships among concepts and inadequate relationships (Gaines & Shaw, 1995). A great advantage of the use of concept maps is that one can have a visual representation of the information (Cicognani, 1999).

Concept mapping helps externalize the cognitive structure of the students' knowledge on a subject (Gaines & Shaw, 1995) representing meaningful relationships between concepts in the form of propositions (Novak,

2001). Concepts and their connections through labels form a concept map, so in a simplest form, a concept map would be just two concepts connected by a linking word forming a proposition.

Another characteristic of concepts maps is that concepts are represented in a hierarchical fashion with the most inclusive, most general concepts at the top of the map and the more specific, less general concepts arranged hierarchically below. The hierarchical structure for a particular domain of knowledge also depends on the context in which that knowledge is being applied or considered (Novak, 2001).

After the conclusion of the learning activities, the learners are required to build a concept map which will represent the set of conceptual meanings embedded in a framework of propositions. This map may be used as an assessment tool of the learners' cognitive academic performance level obtained after the educational activities have been completed.

Concept mapping is considered a critical factor for the best acting in the knowledge creation since it leads the learners to reach meaningful learning (Ausubel, 1968). This demands a great effort on the part of learners to relate the new knowledge with the relevant concepts that they already possess. Another difficulty arises from the conceptual richness to be learned in a new material. When the learner memorizes new information into his/her knowledge structure without relating it to prior knowledge, rote learning occurs. If this relationship is made, the meaningful learned concept stays for a long time, maybe forever, in the learners' memory (Novak & Gowin, 1984; Novak, 1998).

The three requirements are necessary to accomplish a meaningful learning. First, the learner must previously know some information that relates to the new information/ Second, the knowledge to be learned must be relevant to other knowledge and must contain significant concepts and propositions; and finally the learner must consciously and deliberately choose to relate the new knowledge to the knowledge that he/she already knows in some nontrivial way. Concept map is an efficient evaluation tool for meaningful learning.

### **3 Concept Mapping as a Learning Evaluation Tool**

An achievement testing, such as quizzes, tests, examinations, term papers, lab reports and homework are synonymous of learning evaluation techniques to most learners and teachers. Although this kind of evaluation will continue to have an important use in the assessment of learning, a much wider range of practicable evaluation techniques is needed if we are to encourage learners to exploit the most from their evolution potential.

In fact, most tests do not measure the student's knowledge, since there is a surprising lack of correspondence between what the professor thinks he is testing and the actual meanings or thought processes the student is employing. Although a student may be able to solve familiar problems and obtain correct answers in objective tests, other evaluation techniques may show that relevant conceptual misunderstandings exist.

Although concept maps are commonly used as a learning tool, they can also be used as a powerful evaluation tool, thus encouraging students to develop meaningful-mode learning patterns. Concept maps are also effective in identifying both valid and no valid ideas held by learners (Novak, 2001), showing easily and precisely changes in learners' conceptual understanding. Through concept maps is possible to represent how student's conceptual frameworks change as a result from their learning process.

### **4 The Proposed Environment**

The computational environment proposed in this work provides the following facilities: it allows a learning facilitator, possibly a teacher, to establish individual or cooperative evaluation activities in order to fulfill instructional objectives about planned subjects; it allows learners to participate in individual or cooperative evaluation activities; it allows learners to interact with other learners groups or with the facilitator; it allows the learning method based on the Ausubel's meaningful learning theory and the learning through cooperation, based on the interaction among learners of any area of education.

The Web-based supporting environment comprises the following tools:

- A Cooperative Concept Map Editor (CCME), which allows the student to have creative freedom for the construction of the maps in an informal way (Kremer, 1994; Kumar, 1996) without any interference of the system.

- A task scheduler for the facilitator to assign learning evaluation activities to the learners.
- A chat tool for the synchronous communication among the workgroup participants.

The initial screen of the system allows the access to the tools described above. The initial environment screen is started by a browser to make the communication over the network possible.

Using the CCME the facilitator, alone or with the cooperative help of other specialists on the subject, one can build a concept map for the theme in which the learners will be evaluated. Next the facilitator can define and schedule the corresponding learning evaluation activities. That scheduling should supply the instructions for the accomplishment of the activities, deadlines and whether the activities will be individual or cooperative. The task scheduler allows the facilitator also indicating and defining small cooperative groups, besides proposing guidelines and suggestions for the proposed activities.

When in an individual activity, the learner alone uses CCME to build the conceptual map about the proposed subject. When in a cooperative activity, several learners arranged in small groups uses CCME from distant points on the Web to build an online concept map through a cooperative effort. One of the most useful roles concept mapping can play is to aid a group to capture and come to consensus on their collective knowledge regarding some question or set of questions of interest to the group.

Learners can use chat conversation to discuss and clarify fortuitous difficulties and disagreements in building the concept map. Building concept maps through the use of both CCME and chat conversation makes students' thinking visible to themselves and to others. Once made visible, the person's thinking can easily be analyzed, criticized and modified. The facilitator will be able to follow the activities directly or simply observing the execution of the tasks.

Learners can do the following things with the CCME, among other possibilities:

- Create and edit new concept maps.
- Edit existing concept maps.
- Remove the relationships among the concepts from old concept maps.
- Shuffle the concepts and alter the position of the relationships.
- Edit existing concept maps without relationships or with the concepts shuffled in order to allow the learner trying to reconstruct it.

The task scheduler allows the facilitator indicating and defining small cooperative groups, besides proposing guidelines and suggestions for the proposed activities. Learners can access the proposed activities introduced by the facilitator through the task scheduler.

Another facility of the proposed environment allows the learners choose a subject. After that, the environment shows all the concepts related to that chosen subject. This is possible because all the developed concept maps have their concepts stored in a table of the database. Figure 1 shows all the concepts related with the chosen subject.

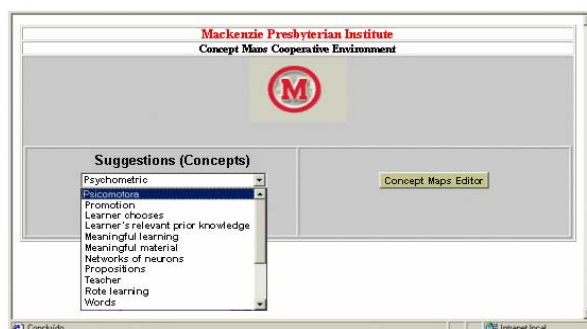


Figure 1. The concepts related to a chosen subject.

In traditional learning methodologies the learners were in a passive position receiving the teacher's knowledge transmission without practically any interaction that allowed the teachers a concrete evaluation of the cognitive students' academic performance level after the completion of the educational activities (Santos, 1997).

After being informed of the completion of the group task, the facilitator liberates the concept map produced by the facilitator in order to learners be able to compare theirs maps with the model map and the facilitator can

compares his/her map with the one produced by the learners, aiming at discovering if the learners reached the established goals, theoretically incorporated in the facilitator map. The facilitator can point out and discuss with the learners possibly misconceptions found in the concept maps produced by the learners. In the future, enhanced versions of the environment will coach and assist the learners during the evaluation activity, based on the facilitator's concept map.

## 5 The Environment Architecture

The architecture of the proposed environment is based on the client/server technology. There will be a server program being executed that just waits, listening to the socket for a client to make a connection request. The client knows the hostname of the machine on which the server is running and the port number to which the server is connected. To make a connection request, the client tries to communicate with the server on the server's machine and port.

The server program will be responsible for the storage of the files that includes the activities proposed by the teacher, concept maps created by the learners and facilitator and all the necessary computational support for the cooperative work accomplished by CCME and for the Chat tool.

Clients applications, that are JSP pages, are accessible for any browser WWW, because when the page is requested by a client and processed by HTTP server, page's HTML part is sent to the client. Server applications they are executed in the server, when the solicitation is received the dynamic content generated by the code it is inserted in the page and sent to the client.

For the administration of the data regarding the concept maps, users, tasks scheduler, cadastre, password alteration and concept maps manipulation, it was implemented a group of programs that is executed under the control of a JSP pages' server.

## 6 Summary

This system offers a computational support tool for the learning evaluation implemented through individual or cooperative educational activities in agreement with the instructional objectives. Allowing the interaction among the learners and facilitator by using synchronous and asynchronous tools facilitates the communication among them and offers a cooperative environment through the Internet. The environment has been used with success in several courses on information technology.

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