The architectural design of a real time collaborative concept-mapping environment from distance

Christos Fidas[1]
Department of Electrical and Computer Engineering, University of Patras, 26500, Rion, Patras, Greece
fidas@hermes.clab.ee.upatras.gr
Vassilis Komis
Department of Early Childhood Education, University of Patras, 26500, Rion, Patras, Greece
komis@upatras.gr

Key words: Collaborative concept-mapping, real time collaboration, children's ideas, cognitive tool, representational tool, open learning environments, collaborative learning, reactive agents, CSCL.

1. Introduction

In this text we present the main pedagogical and technical principles concerning the design of *Representation Tool* (Version 2.0), an open ended educational software for collaborative concept mapping, based on Internet. Concept mapping is one of the most known ways for representing knowledge visually [Novak & Gowin, 1984; McAleese, 1998] and consequently for externalizing the representations of those who learn by using graphs in a tree or network form. The *Representation Tool*[2] equips its users with the appropriate tools for individual and collective expression of knowledge by facilitating the process of handling the concepts and the relations that link them. The Tool provides for the rapid development and exchange of concept maps through its common working environment and access to others creations (concept maps). It also has the potential for simultaneous map development either on local network level or over the Internet that is supported by appropriate dialogue boxes and negotiation tools. The collective development of concept maps and the procedure of negotiation enables real time collaboration, where social – cognitive conflicts are more likely to emerge.

2. Pedagogical Design

The basic principles for the pedagogical design of *Representation Tool* (version 2.0) are:

- *Open learning software for collaborative learning* [Dillenbourg et al., 1996] *and conceptual mapping:* The *Representation Tool* is an open learning software that provides the potential to its users to use it as a cognitive and representational tool which supports, guides and aids expression of ideas and representations while enforcing cognition and culture [Fisher et al, 2000].
- *Expression and investigation through multiple external representations and direct manipulation:* The *Representation Tool* allows the expression and investigation of ideas and understanding of students through the manipulation of simultaneous multiple representations [Suthers, 1999] of analogical and symbolic form.
- *Support of collaborative learning and distributed knowledge* [Scardamalia & Bereiter, 1994; Baker & Lund, 1997; Mühlenbrock & Hoppe, 1999] *with real time collaboration over concept maps:* The working environment of the *Representation Tool* constitutes a collaborating environment for networked users, either locally or on the Internet. Distance collaboration is supported by appropriate communication tools.

The architectural structure of the system consists of six distinguished components:

- a collaboration component for the real-time distant development of concept maps,
- a component for synchronous and asynchronous collaboration and communication,
- a component for concept maps handling,
- a component for handling and creating the objects,
- a component for handling links and
- a special handling component used by teachers or researchers.

3. Technological designing principles

The *Representation Tool*, was developed for MS Windows environment, by employing the object oriented programming approach with components developed in Microsoft Visual C++ and application interfaces such as Win32, Winsock and Wininet. The Tool includes two different subsystems of collaboration: synchronous and asynchronous.

---

[1] Contact Person
[2] The *Representation Tool* (2.0) is the evolution of *Representation Tool* (1.0, April 2000). This software had been developed in **Représentation Project**, Educational Multimedia (project contract 1045), European Union, (http://hermes.iacm.forth.gr).

Subsystem of synchronous Collaboration: This aspect facilitates real - time development of concept maps (in local network or on the Internet). Furthermore, it is supported by other collaboration components such as chat – room and exchanging concept maps in a synchronous way. The subsystem that allows the collaborative construction of concept maps has been designed in a highly structured level in order to reduce the complication of design. The architecture (figure 1) consists of three levels.

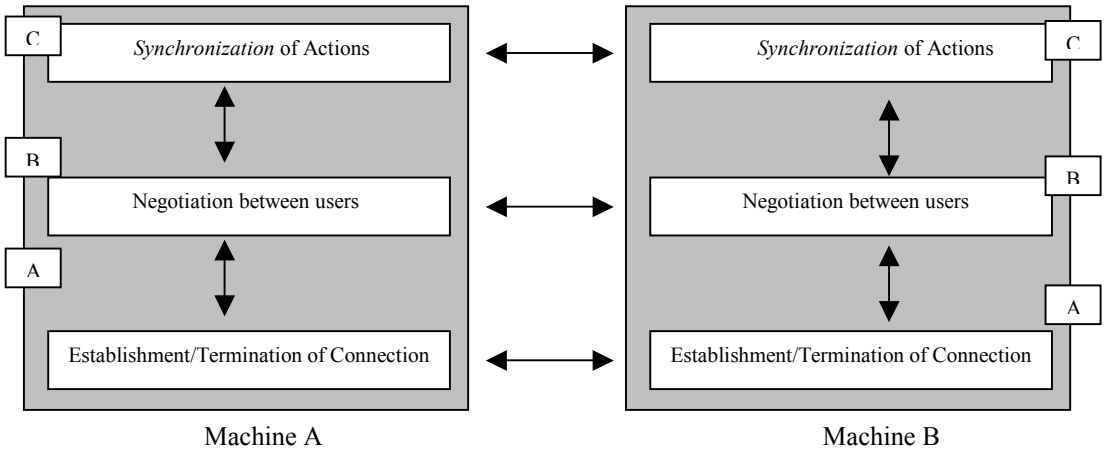

Figure 1: General Architecture of Collaboration System

Level A: Establishment / Termination of connection: The aim of this level is the establishment, maintenance and termination of the connection which is achieved by TCP / IP protocol.

Level B: Negotiation between users: It supports the dialogue between the users for the acceptance or rejection of the request for the collaborative construction of concept maps.

Level C: Synchronization of actions: It displays the active user's actions on the inactive user's screen in real time. A technology of a specific category of agents, known as reactive agents, was used for the achievement of this aim.

Asynchronous Collaboration: The aim of asynchronous collaboration is to allow the exchange of concept maps even if the receiver does not have his software activated at the moment of the exchange. Each time that users activate their software, it is automatically connected to the ftp server and checks if there are any files for them. If there are, it transfers them to the users' computers, it deletes them from the ftp server and informs the recipients with an appropriate message.

4. Discussion – future work

The use of representation tools seems to be effective enough, especially as far as the externalization of the declarative representations are concerned. This problematic is confirmed by the results of recent researches [Komis et al. 2001], with the use of software *Representation Tool*. One of the most interesting subjects that should be researched has to do with the support of activities of concept mapping in cooperation and in what extent the interaction between the users is influenced [Chiu et al., 2000]. In addition, the pedagogical effectiveness of such tools will be shown though the evaluation of software in an environment of joint activities on local network or on the Internet.

References

Baker M., Lund K., (1997). Promoting reflective interactions in a computer-supported collaborative learning environment, *Journal of Computer Assisted Learning*, 13 (3), 175-193.

Dillenbourg P., Baker M., Blaye A., O'Malley C. (1996). The evolution of research on collaborative learning. In Spada E. & Reiman P. (Eds), *Learning Human and Machine: Towards an interdisciplinary learning science*, pp. 189-211, Oxford: Elsevier.

Chiu C.-H., Huang C.-C., Chang W.-T., (2000). The evaluation and influence of interaction in network supported collaborative concept mapping, *Computers & Education*, Vol. 34, pp. 17-25.

Fisher K., Wandersee J., Wideman G., (2000). *Enhancing cognitive skills for meaningful understanding of domain specific knowledge,* American Association for the Advancement of Science, (http://public.sdsu.edu/CRMSE/Fisher-one.com).

Komis V., Avouris N., Feidas C., (2001). Computer Supported collaborative problem solving: Interaction through diagrammatic and free-text communication, *Computers and Education* (ssubmitted).

McAleese R., (1998). The Knowledge Arena as an Extension to the Concept Map: Reflection in Action, *Interactive Learning Environments*, Vol. 6, No x, pp. 1-22, 1998.

Mühlenbrock M. & Hoppe U., (1999). *Computer Supported Interaction Analysis of Group Problem Solving*, Proceedings of CSCL, Stanford University.

Novak, J. & Gowin D.B., (1984). Learning how to learn, Cambridge University Press.

Scardamalia M. and Bereiter C., (1994). Computer Support for Knowledge-Building Communities, *The Journal of Learning Sciences*, 3(3), pp. 265-283.

Suthers D., (1999). *Representational Support for Collaborative Inquiry*, Proceedings of the Hawai'i International Conference on System Sciences, IEEE.