Technology-based Collaborative Learning in Every Day School Practices: Research Directions of Learning Technology & Educational Engineering Laboratory

Angelique Dimitracopoulou, George Fessakis, Argiro Petrou,
Stelios Orfanos, Irene Ioannidou

Learning Technology & Educational Engineering (LTEE) Laboratory,
University of Aegean, GR-85100, Rhodes, Greece
www.rhodes.aegean.gr/LTEE,
adimitr@rhodes.aegean.gr , gfesakis@rhodes.aegean.gr, petrou@rhodes.aegean.gr,
stelios@rhodes.aegean.gr, ioan@rhodes.aegean.gr

ABSTRACT
Four main directions of research were implemented by the Learning Technology and Educational Engineering (LTEE) Laboratory, in order to investigate aspects of technology based learning environments and collaborative learning for: young children, secondary education students, students with special needs as well as teachers. As far as conceptual change is concerned the research interest of the laboratory is focused on the mechanism that relates metacognition and self-regulation, to social negotiation and finally to learning of concepts during computer mediated collaboration.

KEY-WORDS: *collaborative learning, cooperative learning, inquiry learning, scientific modeling, conceptual change, tools supporting metacognition, interaction analysis tools for teachers, special needs, teachers' education, distributed cognition, activity theory*

RELATED RESEARCH DIRECTIONS

Several kinds of scientific activity have been developed by LTEE laboratory during the last five years in order to explore the exploitation of Information and Communication Technologies in implementation of constructivist teaching approaches and to investigate the potentialities of Computer Supported Collaborative Learning in coping with the conceptual change problem.

Collaborative Learning related research in LTEE laboratory was implemented in four different directions:

(i) *Design and implementation of a collaborative modelling environment and learning activities for secondary education,* in different subject matters (physics, chemistry, mathematics, environmental education). It was directed in a number of underlying research aspects:

(a) *Identification of design principles and features that support students* (12-17 years old) *and teachers, in synchronous computer mediated collaboration*. Realistic animations, appropriate cognitive tools and metacognitive support were considered as central features in order to support conceptual change, during the use of MODELLINGSPACE learning environment [Dimitracopoulou & Komis, 2004].

(b) *Conceptual change in science using appropriate modelling activities* [for 14-16 years old]. There is empirical evidence that the learning environment and specific activities allow students to express their intuitive ideas and to change them in order to gradually construct scientific concepts related to kinematics [Orfanos & Dimitracopoulou, 2003].

(c) Exploration of *appropriate conditions for synchronous collaborative learning in everyday school practices.* Comparison of three different settings of synchronous collaboration among collocating students (computer mediated unsupervised collaboration, supervised by teacher and face to face collaboration between two students) gives insights on collaboration quality, while it legitimates the meaningfulness of the activity according the students and teachers points of view [Fessakis, Petrou, Dimitracopoulou 2004b].

(d) *Teachers roles, strategies and tactics while students collaborate among them*. The focus was on identification of teachers' strategies. Collaborative students' activities gives rich material for students' diagnosis. Diagnosis of students' difficulties is a really hard activity for teachers, and if they have the opportunity to apply it, at least to a certain degree, it is significant both for teaching and learning [Petrou & Dimitracopoulou 2003].

(ii) *Distributed learning activities with mobile technology for conceptual change in space related concepts:* Conceptions of technology based learning activities using mobile technology for learning & conceptual change related to the development of intuitions of space concepts and cognitive skills concerning map reading, navigation and construction by young students [5-7 years old]. The design rationale of the proposed learning activities is around the idea of "*Signifié- Signifiant Collaborative Play*" Script. It applies on the assumption that the cognitive operations that are usually performed by an individual (for instance to read a map -2D symbolic representation - and use it to 'move' in the real space - 3D natural space-) could be distributed over two group of individuals communicating with each other while working in one of the two representational mode. The objective was to incite children to *decenter* (from their own perspective, as well as from specific representational media) and to develop '*empathy*' (considering that another may have a different point of view [Ioannidou & Dimitracopoulou, 2003a, 2003b). The analysis of learning mechanisms and effects was mainly based on the analysis of cognitive processes during intra-group interactions as well as inter-group interactions involving relations and interactions among individuals and artifacts.

(iii) *Communication and collaboration using web based tools, for students with physical disabilities* (12-15 years old): Combination of synchronous and asynchronous communication and collaboration, under meaningful learning activities in the frame of computer science courses, seems to improve in a significant way students' collaboration abilities and therefore to change positively students' roles and status in small and large scale social groups [Petrou & Dimitracopoulou 2004].

(iv) *Cooperative and collaborative learning during teachers' education:* Educational program of teachers' education in "ICTs in Education" subject that is based on a mixed program of face to face seminars and distance learning program, is intended to create a Virtual Learning Community of Teachers. The research was focused on the appropriate politics, means and tools that could allow teachers to collaborate and cooperate in order to change their ideas, strategies & practices related to the innovation implementation possibilities [Χλαπάνης, Μπράτιτσης, & Δημητρακοπούλου, 2004; Bratitsis, Hlapanis, Dimitracopoulou, 2003].

MAIN ASSUMPTIONS AND THEORETICAL FRAMEWORKS

The applied theoretical framework is mainly based on:

(A) Cognitive psychology, science and mathematics education, where: (i) science learning is characterised by misconceptions [Driver, 1978; DiSessa, 1982; Viennot, 1979] (ii) a first step of conceptual change is the emergence of these misconceptions from the part of the students and the diagnosis of them by the teacher [Vosniadou, 2001] (iii) the role of explanation in conceptual learning is significant [Chi et all 1979], (iv) the social confrontation of the (pre)scientific' knowledge is claimed by epistemology, (v) there is a need to facilitate 'metaconceptual awareness and metacognitive support [Vosniadou, 1994; 2000].

(B) Computer Support for Collaborative Learning (CSCL) field research, which gives hints that under appropriate conditions synchronous computer mediated collaboration could incite explicitation, argumentation and explanation triggering, comparing to the typical class situations of school problem solving (where, students solve problems alone, expressing only the final product, e.g. a series of equations and a series of algebraic manipulations).

(C) The consideration of the school community, their practices, their rules and their conditions: school program, needs of teachers, typical course topics, etc. A continual effort to implement innovative approaches in typical school or professional context, taking into account the current conditions and intervening factors, in order to really support learning activities' participants.

The Design Rationale of computer mediated collaborative setting is related to students and teachers expectations:

- *Regarding students*: To increase the possibilities of *explicitation, argumentation, decentering* and *explanation* triggering, in comparison to individual activity or collaborative side-by-side activity, that is usually applied in class.
- *Regarding teachers*: To provide tools and means for a detailed diagnosis of students' conceptual understanding and difficulties on specific activities processes, as well as to provide tools for social awareness.

The application of the collaborative setting is intended to support learning through three complementary approaches: (i) Structuring the collaborative activity process in order to favour the emergence of productive interactions, (ii) Supporting students to self-regulate their activity, (iii) Monitoring students' interactions by the teacher (on the fly or afterwards) [Fessakis, Petrou, Dimitracopoulou 2004a]. The proposed approach determines some significant application conditions, in everyday educational practice: (a) The selection of critical instances of this setting application related to every day courses (e.g. conceptual understanding, strategies for inquiry or modelling), (b) The application of appropriate structured scripts that involves: individual work, synchronous computer mediated activity, face to face activity and social activity with the 'whole class' or group, (c) The existence of appropriate interactions' analysis tools, that support students in a metacognitive level, (d) The existence of interactions' analysis tools appropriate to support teachers in a diagnosis level as well as in a teaching strategies self-regulation level.

It is to be noted that different social constructivist theories [e.g. Distributed Cognition Theory, Activity Theory] were proved appropriate in order to analyze collaborative interactions and identify conceptual change, in the previously mentioned researches.

OPEN QUESTIONS AND FUTURE DIRECTIONS

As far as the conceptual change is concerned the research interest of the laboratory is focused in the mechanism that relates metacognition and self-regulation, to social negotiation and finally to the learning of concepts during computer mediated collaboration. Furthermore, there are currently some relevant and rather component research interests that are formally attended in the framework of research projects. More specifically questions concerning the collaboration analysis tools supporting students as well as teachers are continuously examined [e.g. ICALTS project]. In addition, design and representation of general purpose collaborative learning scripts is aimed (e.g. MOSIL project) exploring also collaborative learning activities using mobile technologies that are

promising to overcome some of the limitations of the computer room based activities and enable a more integrated mode of technology exploitation. Finally, the explicit goal to support the diffusion of computer supported collaborative inquiry learning to the European school practice, is promoted via a synthetic approach of different complementary learning environments (CoLab, VITEN, and MODELLINGSPACE, see RECOIL project) related to learning sciences.

REFERENCES

Bratitsis, T., Hlapanis, G., & Dimitracopoulou, A., (2003). Continues education of teachers on ICTs in education through e-Learning community activities. Pilot study on a custom built environment," In proceedings of the *6th International Conference on Technologies in Mathematics Teaching*, 9-13 October, 2003, Volos, Greece.

Dimitracopoulou, A. & Komis, V. (in press 2004). Design Principles for an open modeling environment for learning, modelling & collaboration in sciences, In C. Constantinou, Z. Zacharia, K. Commers, (Guest Editors), *International Journal of Continuing Engineering Education and Life-Long Learning (IJCEELL),* Special issue on The Role of Information and Communication Technology in Science Teaching and Learning

Dimitracopoulou A. & Petrou A. (in press 2004). Advanced Collaborative Distance Learning Systems for young students: Design Issues and current trends on new cognitive and metacognitive tools. In *Themes* Journal, Special Issue, *Issues and Trends regarding the Application of Information and Communication Technologies to Distance Learning,*

Fessakis G., Petrou A., Dimitracopoulou A., (2004a) Collaboration Activity Function: An interaction analysis' tool for Computer Supported Collaborative Learning activities, In *4th IEEE International Conference on Advanced Learning Technologies (ICALT 2004),* August 30 - Sept 1, 2004, Joensuu, Finland.

Fessakis, G., Petrou, A. & Dimitracopoulou A., (2004b). Synchronous Collaboration among collocated students in everyday school activities: Exploring Conditions for meaningful learning activities. *CSCL Symposium*, Kaleidoscope NoE, 9-10 October, 2004, Lausanne.

Ioannidou, I. & Dimitracopoulou, A. (2003a). Design of distributed collaborative activities for young children related to map use and construction. In proceedings of the *IASTED International Conference*, 30 June-3 July 2003, Greece, pp.511-521

Ioannidou, I. & Dimitracopoulou, A. (2003b). Young Children Collaborating to use Maps during Technology based Distributed Learning Activities In proceedings of the *6th International Conference on Technologies in Mathematics Teaching*, 10-13 October, 2003, Volos, Greece.

Orfanos, S. & Dimitracopoulou, A. (2003). Technology based modelling activities in learning concepts relations in kinematics. In A. M. Vilas, J.A. M. Gonzalez, J. M. Gonzalez (Eds) Advances *in Technology-Based Education: Toward a Knowledge-Based Society*. II International conference on multimedia ICT's in Education, Badajoz, Spain, Dec 3-6 2003, Edition: Junta de Extremadura, Consejeria de Education, Volumes: I-III, Collection.

Petrou, A., & Dimitracopoulou, A., (2003) "Is synchronous computer mediated collaborative problem-solving 'justified' only when by distance? Teachers' points of views and interventions with co-located groups, during everyday class activities", In B. Wasson & U. Hoppe (eds) *Proceedings of 2nd European CSCL congress*, Bergen, June 14-18, 2003, pp. 369-377., Kluwer editions.

Πέτρου, Δ. Ρ. & Δημητρακοπούλου, Α. (in press, 2004). Τεχνολογίες της Επικοινωνίας για παιδιά με σωματικές αναπηρίες. Βελτίωση της επικοινωνίας και της συνεργασίας στα πλαίσια μικρής τοπικής ομάδας αλλά και ευρείας εικονικής κοινότητας, *Περιοδικό Ειδικής Αγωγής*.

Χλαπάνης, Γ., Μπράτιτσης, Θ., & Δημητρακοπούλου, Α. (in press, 2004) Επιμόρφωση Εκπαιδευτικών μέσω δραστηριοτήτων *Ηλεκτρονικής Κοινότητας Μάθησης:* η περίπτωση της *Πιλοτικής Κοινότητας* του Πανεπιστημίου Αιγαίου, Περιοδικό *Επιστήμες Αγωγής*