Συνέδρια της Ελληνικής Επιστημονικής Ένωσης Τεχνολογιών Πληροφορίας & Επικοινωνιών στην Εκπαίδευση

Τόμ. 1 (2006)

5ο Συνέδριο ΕΤΠΕ «Οι ΤΠΕ στην Εκπαίδευση»

Collaborative Interaction Analysis: the Teachers' Perspective

Eleni Voyiatzaki, Meletis Margaritis, Nikolaos Avouris

■ COLLABORATIVE INTERACTION ANALYSIS: THE TEACHERS' PERSPECTIVE

Eleni Voyiatzaki
evoyiatz@ee.upatras.gr

Meletis Margaritis
margaritis@ee.upatras.gr

Nikolaos Avouris
avouris@upatras.gr

HCI Group, ECE Department
University of Patras, Greece

Abstract

Collaborative Interaction Analysis involves quantitative and qualitative techniques of coding and interpreting recorded group activities, mostly used by researchers of Computer Supported Collaborative Learning (CSCL). These techniques are usually tedious and necessitate specialized knowledge, so they are not suitable for everyday class practice. A hypothesis investigated in this paper is that such methods in a simplified version, if supported by adequate tools may be useful in design, implementation and evaluation of collaborative activities by teachers. The Synergo Interaction Analysis Tool is proposed for such use and an example of collaborative problem solving activity analysis by teachers during a collaborative activity is discussed as evidence of the effectiveness of this proposal.

Keywords

Interaction analysis, synchronous collaboration.

INTRODUCTION

In recent years research and practice in Computer Supported Collaborative Learning has produced methods and tools supporting both learners and teachers engaged in collaborative learning activities (Dillenbourg et al 1996, O'Malley 1995). In order to understand and support collaborative learning, various approaches have been proposed to analyse the interactions that take place during a CSCL activity (e.g. Soller et al 2005). While collaborative interaction analysis is mainly used by researchers for understanding the collaborative learning process, it is worth investigating the suitability of such approach and of relevant tools for teachers in their everyday activities. The needs of these two groups however vary. Researchers are interested in the outcomes of interaction analysis according to their theoretical perspective and research hypothesis, based on pedagogical, cognitive, or psychological view of the process. The objective is to obtain enough evidence in the form of consistent and reliable data, using models of analysis that can be reused or generalized, and conclusions that improve existing tools, methods and the established understanding of collaborative learning. Both these groups share the objective to make students' thinking visible, in order to evaluate and support learning. We may argue that this objective can be an important motive for a teacher (Dimitracopoulou 2005), to use CSCL tools and Collaborative Interaction Analysis tools, in real classroom settings. A teacher is a designer of the educational experience, a facilitator towards active and successful learning, and as a subject expert may scaffold the learning experience (Anderson 2001). In addition, in all education levels the teachers are expected to assess and evaluate student's learning outcomes using various methods. Teachers need to overview the class learning outcomes, to focus on specific groups' and individual students' activities as well as to self evaluate their own teaching. Interaction analysis tools may be used to support these objectives, if the teachers are provided with appropriate tools along with relevant, usable, well focused and concise scenarios of their use, and are supported them to adopt such practices.

The work presented in this paper is concerned with the conceptual architecture of the Synergo Analysis Environment, a set of Interaction Analysis tools appropriate for synchronous collaborative learning situations. The use and appropriation of these tools by researchers in collaboration with teachers (referred as end users), during a case study, is discussed. The interaction analysis tools were expected to give to the end users, and especially teachers, an overview of the learning activity as well as an in depth understanding of the process. The use of Synergo Analysis Tools during the assessment and evaluation process of a specific activity and the conclusions from this process are presented and briefly discussed.

FROM CONCEPTUAL DESIGN TO USE CASES

Synergo (www.synergo.gr) is an open source synchronous collaboration support environment made of both a *Collaborative Mapping* and of a *Collaborative Interaction Analysis tool* (Avouris et al 2004). Synergo combines these two tools in a client-server distributed application, supporting synchronous collaborative based activities of small groups. Synergo has been used in cases of individual and collaborative building of various kinds of graphic representations of problems, like flowcharts, entity-relationship diagrams, concept maps, data flow diagrams etc. Record of the activity is produced in the form of a *log file*, which is available for inspection and processing in the Synergo Analysis Environment.

The collaboration environment of Synergo is shown in figure 1. The main activity space may be shared by multiple actors, permitting collaborative problem solving activities of actors collocated (e.g. in a classroom) or at a distance. Synchronous collaboration in Synergo is based on shared artifacts in the work surface. As a result, the other participants can observe one participant's manipulation of work surface objects. This communication through the artifact can be as important as direct communication between participants. A *dialogue tool* (chat) is integrated in Synergo. Through this, text messages are exchanged during collaborative activities.

The most innovative part of Synergo is the *Collaborative Interaction Analysis Environment* that is the focus of this paper. In this environment the log files produced during collaborative activities may be viewed and processed. These log files contain in XML form description of users actions and exchanged text messages and are used for generation of various views of the collaborative process. The attributes of the event in the logfile are generated automatically by the Synergo environment, as they represent the type of action of the user in the common activity space, while there are attributes that may be assigned by the end user during the analysis process (e.g. Interpretation of a chat message as a "*Suggestion*").

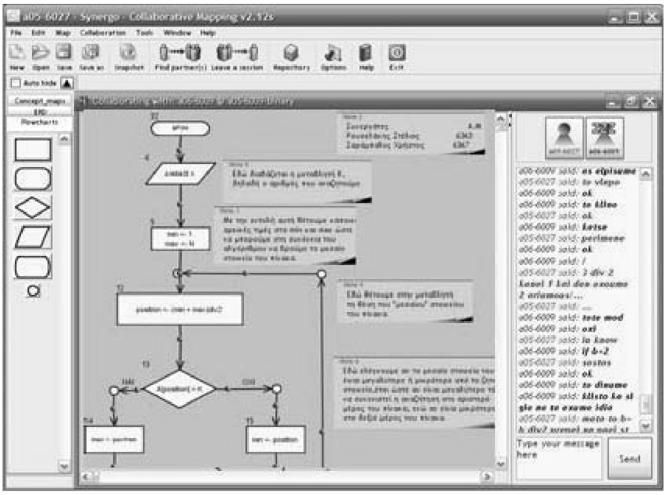

Figure 1. Synergo Collaborative environment.

Conceptually three views are supported:

Quantitative view of the collaboration process at various levels (individual, group, sets of groups, class, and set of classes)

Playback of the collaborative activity of each Group and

Qualitative views at various levels of analysis (learner, group, sets of groups, class, sets of classes) according to indicators that are defined by and used for the interaction analysis by the end user (e.g. qualitative annotation of collaborative process, of problem solving process, of assessment process etc).

The class overview addresses the need for an overview of the activity. The unit of analysis in this case is the group. At the end of a collaborative learning activity in a typical class, the end users are able to select from some *indicators* and create specific views at the class level. The selection of the indicators depends on the collaboration and task scenario. The indicators are automatically calculated from the log file of each group. Average values at the class level are also presented.

Examples of indicators that can be defined for each group and then produced for the whole class include the group activity duration, number of shared actions, symmetry of actions, number of chat messages, number of final objects created, etc. In figure 2a, a tabular representation of a class made of 15 groups is shown, including an example of a graphical representation (of the actions in the shared activity space per group).

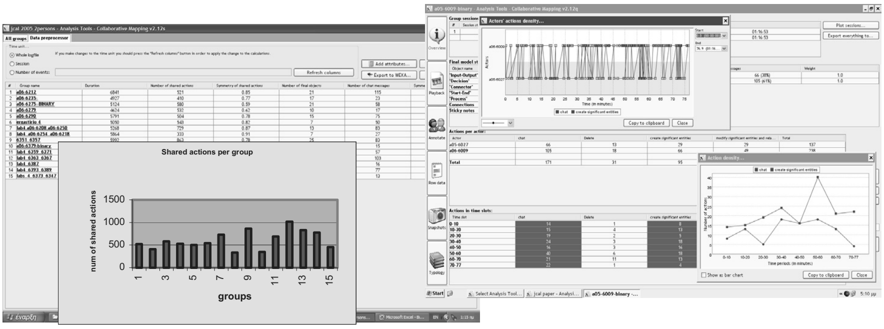

Figure 2. a) The Class Overview b) the Group overview with examples of graphs of selected indicators.

The Group overview is based on a specific group activity log file. A large number of indicators may be defined and accordingly presented in a visual form in this view. They can be related to the density of occurrence of a type of event per time interval tq which is defined by the end user (e.g. number of exchanged text messages or new objects per tq, etc) or related to the degree of symmetry of activity by the group members which actually describes the relative contribution of the group members in a specific type of event. The indicators are shown in tabular or graph form, along the time dimension, or per actor (see figure 2b).

Playback of group activity is focused on the process and not on the final outcome (Voyiatzaki & Avouris 2005). More specifically, using this subset of tools the end user can reproduce the students' activity exactly as it occurred, thus investigating all the intermediate steps of the process. The playback may give the teacher the opportunity to discover misconceptions while students negotiate and act in the shared activity space. The experienced end user is also able to take snapshots of interesting phases of the process in order to keep a record of the activity and even to create an image sequence for later analysis.

Quantitative indicators of group activity can be valuable for end users but their interpretation is often not univocal and their comprehension may be demanding especially for not experienced teachers. On the other hand, a teacher in an everyday classroom is mostly interested on the quality of the students' results, the activity process and the learning outcome.

Teachers often annotate students work with comments and suggestions, subsequently giving them to students for reflection, or transforming these quality indicators to quantitative ones (marks) during assessment and evaluation of the results.

To support this process the teacher, may use adequate tools to obtain **qualitative views of the process**. The teacher can decide the annotations that are important for each activity and create an appropriate scheme. In this case the teacher may annotate not just the outcome but also the dialogue, while reviewing the whole activity. It may be useful to build libraries of annotation schemes that are reusable in future activities. The annotation process is considered a time consuming process, for a teacher, since it is manual, but this depends on the annotation objective, on the depth and on the extend of the annotation scheme and the annotation process.

Moreover, due to the fact that the written dialogue has a direct relation with the actions and the objects of the shared workspace, the teacher can attach each partner's utterances to specific objects. These can either be concrete objects in the workspace or they could be more general concepts or abstract notions that were elaborated by the users but didn't show up as real objects in the workspace.

The teacher can define such typical concepts (after they have been identified in a dialogue) and attach annotated dialogue parts to them. The annotated dialogue can be an interesting input in the group overview. The teacher can enrich the overview with the indicators that correspond to the annotation scheme used. Visualization of the annotated activity can be performed in a similar way as the indicators that were automatically deduced, described above. Further statistical analysis of the annotations can be performed. An example of an annotation scheme to be used by a teacher is shown in figure 3a.

A CASE STUDY

In order to demonstrate the usability of the proposed analysis tools by end users (both researchers and users) in this section we present an example of their application in evaluation of group activities. The study took place in the frame of an *Introductory in Computing* first year course, part of a Computer Engineering University degree program. The activity was designed by the teaching staff in the form of a lab session. The teaching subject was related to Algorithms. The teaching staff was observed and interviewed, as they evaluated the lab work during two consecutive years. The objective of the study was to examine how feasible is the use of Synergo Analysis Tools to identify patterns of collaboration activity in such setting that may lead to learning, and especially for the teacher. In both cases the task did not demand special skills.

During the first semester of 2004-2005 a class of forty-six students (46), age 18-19, forming 23 dyads, were engaged in an activity that lasted one lab session (class04). Following the analysis of the first year of the University activity, some modifications and improvements were made in the subsequent year: (e.g. the time given for the task was longer). The students were motivated to work collaboratively, as collaborative attitude was one of the criteria of evaluation of the assignment.

The second phase of the study took place during the first semester of 2005-2006. A class of thirty four (34) students, of similar characteristics formed 17 groups of 2 students each (class05). The activity lasted one lab session of two hours duration. The groups were created randomly.

The students were asked to express in a form of a flowchart the algorithms that solve specific problems. The activities involved algorithms exploitation and building, using diagrammatic representations in *Synergo*. The activities were appropriate for a typical laboratory session of the respective courses, and were designed together with the teacher in such a way to promote collaboration of students in groups, of two students each.

Students were requested to explore these algorithms using mental execution of the models in order to test their behaviour. The students groups were located in distant parts of the same classroom that communicated exclusively through the Synergo chat tool. The teaching staff was strongly involved in the design of the activity, the classroom work, and the analysis and evaluation of the learning outcome afterwards. In both phases of the study the teacher evaluated the final outcomes of the students' activities, submitted as Synergo log files and associated solutions in the form of a diagram. The activity log files provided the teacher with the view of the process (e.g. students' reasoning, collaboration actions, and learning process) through the playback tool of Synergo. The teachers have used analysis tools during the assessment and evaluation process.

Analysis of Collaborative interactions: the quantitative and qualitative views

Analysis and assessment of students' work is a process depending a great deal on the subjective view of the teacher. During the evaluation process in our study the teachers discussed an initial 'hypothesis' on the student's comprehension on important abstract concepts and then followed various evaluation strategies, either proceeding from a class quick overview to specific groups activities or from group activities to the class overview or a mixed scheme. Generally teachers wished to have available a quick overview of the class concerning the key points of the activity or even the milestones.

The teachers and teaching assistants that were involved in the assessment and evaluation process were familiar with Synergo. Training on *Interactive Analysis Tools* however was considered necessary. Initially, the *class overview* tools helped the teaching staff to select a sample of group activities as pilots at the beginning of the analysis. The most active groups, identified by the high number of events, as well as the symmetry of activity of the group members during the building of the diagram, were studied first. Next the playback tool was used for the assessment of all group activities. It was very interesting for the teachers to find out that in some cases during the process some groups changed completely their solution after discussion and negotiation.

The teacher was able to notice typical group behaviour. For example: some groups built a sequential diagram of the algorithm first and afterwards they tried to create the loop structure that was required, while others tried from the very beginning to build the loop structure and afterwards to complete the rest of the algorithm.

The criteria for work assessment were initially established as: (a) the degree of collaboration (b) the thoroughness of the algorithm building and exploration process and (c) the quality of the final solution.

Following an annotation scheme was proposed by researchers to include the criteria and key issues according to the initial hypothesis that were described above:

(a) *Single exchanges between partners*: Social or off-task interactions (So), Query (Q), Answer (A), Instruction (I), Coordination (Co).

(b) *Complex and extended peer learning interaction*: Explanation (E), Tutoring (T),

(c) *Conflict resolution and negotiation*: Discussion (DI), Negotiation (N),

(d) *Correctness and completeness control and meta-cognitive activity*: Discovery (D) patterns related to control on algorithm correctness, completeness or termination.

The analysis using this annotation scheme was made by researchers with the participation of the teachers as it was considered to be a demanding process.

This analysis came up with interesting finding for the researchers. Teachers considered the task time consuming, for an every day class. However, they proposed a new annotation scheme, closer to their ordinary assessment activities. This scheme included annotation codes of the dialogue according to its relation to (a) important actions (b) critical actions (c) important misconceptions, (d) building solution actions (e) irrelevant actions (e) questions, (f) answers (g) explanations and (h) tutoring patterns. This annotation was similar to the comments that a teacher may use on a group's activity worksheet. The teachers had annotated selected group activities. They considered that the annotation process can be useful, since they can create their own schemes relevant for each teaching activity and scope of use (e.g. assessment, commenting activities to support groups for further reflection) . The time needed may vary according to their expectations, which are different from the ones of the researchers, that make the process too time consuming.

A typical graph of an annotated group activity, according to the new scheme, shown in figure 3b, identifying the prominent role of the second user, was confirmed through more detailed study of the log file.

It should be observed that the coding scheme used in this case did not necessitate consistency and reliability check (Strijbos et al 2006), as in research studies, since usually only one teacher performed the analysis of one specific class.

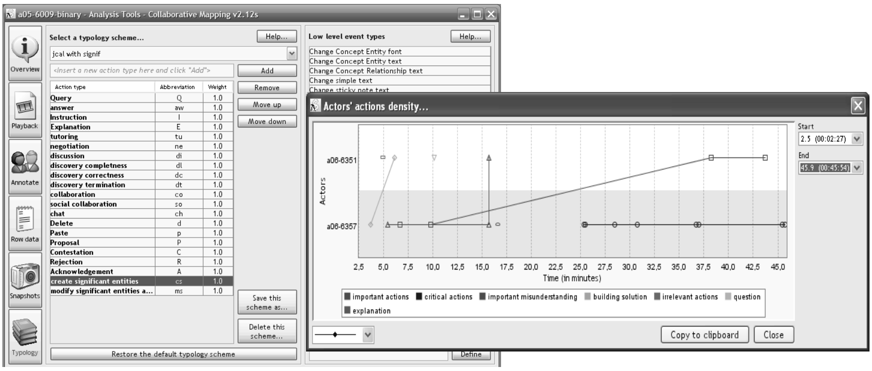

Figure 3. a) Creation of an Annotation Scheme b) A typical graph of an annotated group activity.

CONCLUSIONS

The use of interaction analysis tools, like the *Synergo Analysis Environment*, presented here, can be useful to teachers and valuable to the improvement of the teaching and learning process. Well designed and focused activities, along with appropriate tools and scenarios of analysis seem to be critical factors of success. Features of the tools used, that cover existing needs, like playback, have been easily adopted by the teachers in the presented case study. The flexibility of parametric annotation and overview tools provided the teachers with the possibility to customize them to their own needs and to reuse them, even if the specific tools were originally considered more appropriate for researchers. The simplicity of the annotation scheme used did not match coding scheme used in research in dialogue and interaction analysis, however it was considered suitable and similar to schemes used for annotation of student work in more traditional media, eg paper and pencil environment.

REFERENCES

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*, pp. 189-211, Oxford: Elsevier.

O'Malley C. (1995) Computer Supported Collaborative Learning. *Springer Verlag*, Berlin, Germany.

Soller, A., Martinez, A., Jermann, P. and Muehlenbrock, M. (2005). 'From Mirroring to Guiding: A Review of the State of the Art Technology for Supporting Collaborative Learning', *Int. J. of A.I. in Education,* 15, pp 261-290, 2005

Dimitracopoulou A. (2005), *'Designing Collaborative Learning Systems: Current Trends & Future Research Agenda'* , *CSCL2005* , Taipei.

Anderson, T., Rourke L., Garrison D.R. and Archer W.,'Assesing Teaching Presence in a computer Conferencing Context' *JALN* Vol 5 Issue 2, 2001

Avouris N., Margaritis M., and Komis V., 'Modelling Interaction during small-group Synchronous problem solving activities: the Synergo approach' *2nd International Workshop on Designing Computational Models of Collaborative Learning Interaction,* ITS 2004, Brazil 2004.

Voyiatzaki E., Avouris N., (2005). 'On teachers' involvement in design and evaluation of collaborative activities: Case studies in Secondary and Higher Education', *Proc. Computer Supported Inquiry Learning workshop*, May 2005, Genoa, available from hci.ece.upatras.gr.

Strijbos J.W., Martens R.L., Prins F.J., Jochems W.M.G., (2006) Content analysis: What are they talking about?, Computers & Education 46, pp. 29–48.