Collaborative Interaction Analysis: The Teachers' Perspective

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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.

1. Introduction

In recent years research and practice in Computer Supported Collaborative Learning has produced methods and tools for both *learners* and *teachers* engaged in collaborative learning activities ([1], [2]). 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. [3]). 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 requirements of teachers are however very different than those of the researchers. The researchers are interested in the outcomes of interaction analysis according to their theoretical perspective and research hypotheses, 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 reach conclusions that improve existing tools, methods and the established understanding of collaborative learning.

On the other hand, both teachers and researchers of CSCL 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 [4], 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 [5]. In addition, in all education levels the teachers are expected to assess and evaluate student's learning outcomes using various methods. Teachers often 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 to adopt such practices.

The work presented in this paper is concerned with possible use of the *Synergo Analysis Environment*, a set of Interaction Analysis tools by teachers in synchronous collaborative learning situations. The appropriation of these tools by researchers in cooperation with teachers, during a case study, is discussed. The tools were expected to give to the teacher an overview of the learning activity as well as an in depth understanding of the process. The use of Synergo Analysis Tools for a specific activity assessment and evaluation, and the conclusions from this process are presented and briefly discussed.

2. From conceptual design to use cases

Synergo (www.synergo.gr) is an open source synchronous collaboration support environment comprising both a *Collaborative Mapping* and of a

Collaborative Interaction Analysis tool [6]. 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 collocated actors (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.

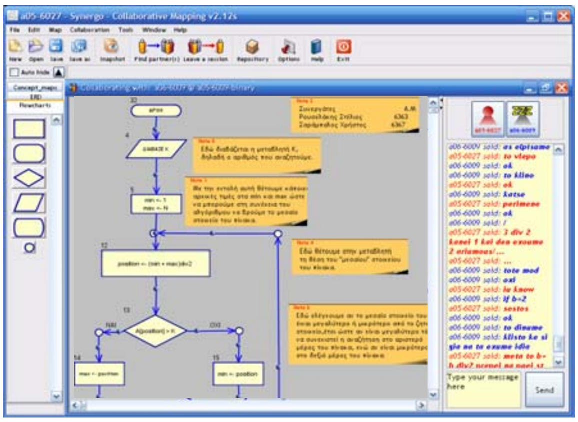

Figure 1. Synergo Collaborative environment

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. Each event of the log file is defined as a tuple $E_{i_{AOT}} = (t_t, A_A, [O_O], [T_T])_i$ where $i \in [1, m]$, t the event timestamp, A the actor who created the specific event, O an optional parameter referring to the object of the specific operation and T an optional code which interprets the event according to the analysis framework T. Some of these codes are generated automatically by the Synergo environment, as they represent the type of action of the user in the common activity space (e.g. *Insert* of new entity in the activity space), while some codes may be assigned by the researcher during the analysis process (Interpretation of a chat message as a "*Suggestion*").

Conceptually four views are supported:

Quantitative view of the collaboration process at various levels (individual, group, set of groups, class, set of classes) through statistical indices

The Process View in the form of playback of the activity and

Qualitative views at various levels of analysis (learner, group, sets of groups, class) according to indicators derived from interaction analysis by the user (eg qualitative annotation of collaborative process, of problem solving process etc).

Raw data view provides access to data of activity logs.

A more detailed presentation of these views with comments on their use by the teachers is included next.

The Class overview provides *an overview of the activity* at the level of a whole class. In a typical class, the user is able to select some *indicators* and create specific *views* at the class level. The selection of the indicators depends on the *collaboration and task scenario*, the user's *initial hypothesis*, and *observations* made during the activity. The indicators are automatically calculated from the log file of each group.

Examples of indicators include the group activity duration, number of shared actions, symmetry of actions, number of chat messages, number of final objects created, etc. In figure 2, a tabular representation of a class made of 15 groups is shown, including one indicator, i.e. an example of a graphical representation (of the actions in the shared activity space per group).

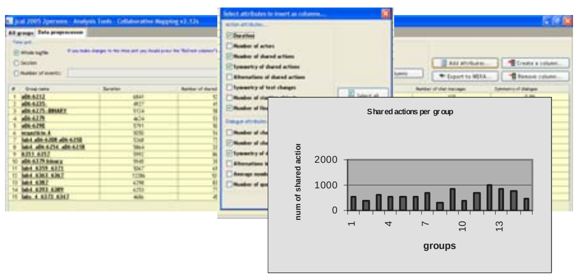

Figure 2. The Class Overview

The Group Level view is used to *focus on a specific Group activity and student's contribution* based on a the group activity log file. A large number of *indicators may be defined* and accordingly *presented in* *a visual form* in this view (figure 3). Some of these indicators relate to the density of occurrence of a type of event per time interval t_q, like the number of exchanged text messages per t_q, where the user is defining the time interval t_q., and other calculate the occurrence of certain types of events and generate group indicators e.g. the degree of symmetry of activity by the group members. The indicators are shown in tabular or graph form, along the time dimension, or per actor (figure 4).

Process view that permits Playback of group activity is *focused on the **Process** and not on the final outcome* [7]. More specifically, using this tool the 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. An experienced user may also be able to *take snapshots of interesting phases of the process* in order *to keep a record of the activity*, to produce a sequence of images of the process for further analysis and annotation, in parallel with the observation notes. However this is not a typical every day task of a teacher, but it can be used for the design or improvement of a series of activities included in a course.

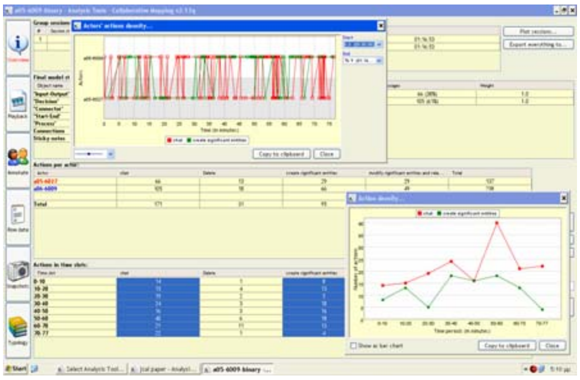

Figure 3. The group Level view - with examples of graphs of selected indicators

Quantitative indicators of group activity can be valuable but their interpretation is often not univocal and their comprehension may be demanding 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 returning them as feedback to them, or transforming these quality indicators to quantitative ones (marks) during assessment and evaluation of the results.

To support this process the researcher and potentially the teacher, may use adequate tools to obtain **qualitative views of the process**. The user can choose annotations and create a scheme, meaningful according to the activity, and the intended use of the annotated files. In this case, the user 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 complicate and 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 direct relation to the actions and the objects of the shared workspace, the user 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 students but didn't show up as real objects in the workspace.

The user 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 user 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.

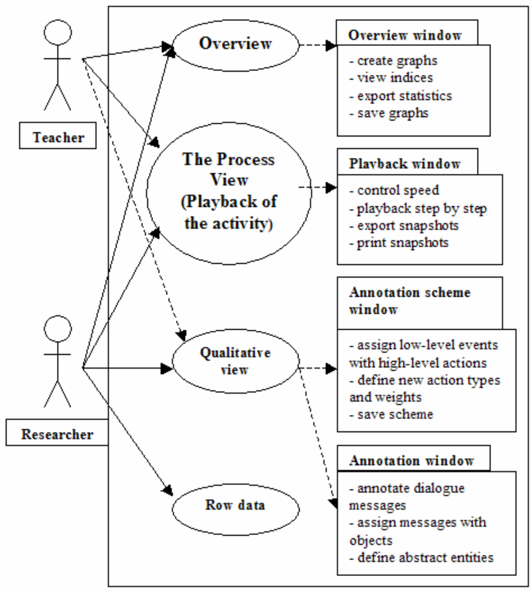

Figure 4. Synergo Analysis Tools use cases for teachers and researchers.

In summary, the typical use cases for a teacher (figure 4) are related to the *Overview* and *Process view* tools, and potentially the *Qualitative view* tools.

3. Analysis of Collaborative interactions: the quantitative and qualitative views during a case study

In order to demonstrate the use of the proposed analysis tools by teachers 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 teaching subject was related to Algorithms. The teaching staff designed the activity in the form of a lab session. They were observed and interviewed, as they evaluated the lab work during the consecutive academic years.

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: The time given for the task was longer. The students were motivated to work collaboratively, as collaborative attitude was one of the evaluation criteria of activity.

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 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*, and were appropriate for a typical laboratory session of the respective courses. The students groups were located in distant parts of the same classroom that communicated exclusively through the Synergo chat tool.

The teacher in both cases was strongly involved in the design of the activity and the classroom work. The teachers and teaching assistants that were involved in the analysis and evaluation of the learning outcome were already familiar with Synergo. Training on Interactive Analysis Tools however was considered necessary. In both cases the task did not demand special skills. The final outcomes of the students' activities, that were analyzed, were the submitted Synergo log files and the associated solutions in the form of flowchart diagrams.

Analysis and assessment of students' work is a process depending a great deal on the subjective view of the teacher. In algorithm building and exploring activities, many teachers, depending on the activity, decide critical steps that expect their students to follow, the milestones they expect them to pass, which are usually connected with the completion of subtasks, or comprehension of important abstract concepts (hypotheses). These hypotheses are defined during the *design of the activity*, and are refined during *the classroom work,* to be used during *the assessment and evaluation process of the activity*.

In our study the teachers defined and refined their own initial 'hypothesis' on the student's understanding of important abstract concepts. During the analysis of the students' outcomes they followed various analysis and 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.

In general teachers wished to have available a quick overview of the class, concerning the key points of the activity or even the milestones. The criteria for assessment of student's work were 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.

It was found that 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.

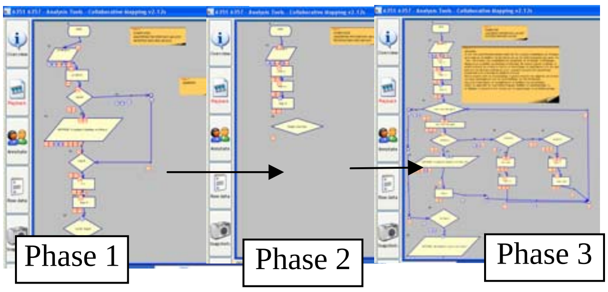

Figure 5. The instances of the playback that shows backtracking in diagram building

The Process View tools and especially the playback tool were used for the assessment of all groups' activities. Teachers were able to discover that in some cases during the process some groups changed completely their solution after discussion and negotiation. (A typical example is shown in figure 5).

The **Qualitative View**, that is usually produced through a long and tedious annotation of the activity process, seemed at first not suitable for the teachers. At first they considered the task time consuming. However after the use of the tool was demonstrated to them, they came up with the proposal of a new annotation scheme, closer to their ordinary assessment and commenting activities on students worksheets.

The teachers' annotation scheme included the following codes: (a) important actions (b) important misconceptions, (c) solution building actions (d) irrelevant actions (d) tutoring patterns. They analysed selected students' activities, created graphs like the one in figure 6. This indicated occurrences of different types of events in an extract of activity of two students. The actions of the two students are included in the top and the bottom part of the graph. By inspecting the graph, the prominent role of the second student is evident, as more events are depicted on the bottom part of the graph.

Finally through the interview, it was found that the teachers thought that the annotation process can be useful, since they can create their own schemes, relevant for each teaching activity and scope of use (eg assessment, commenting activities to support groups for further reflection). The time needed varied according to the specific scheme.

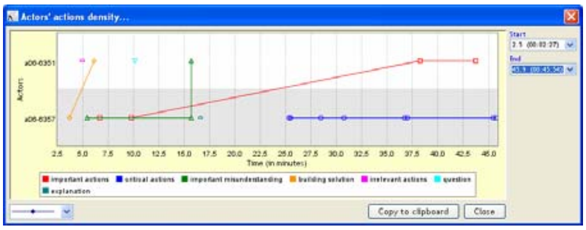

Figure 6 .Graph of group behaviour

4. Conclusions

In this paper we discussed the idea of using complex analysis tools as aids in everyday teachers' activities. An environment that is capable of recording collaborative learning activity and subsequently producing various views of the activity, in the form of statistical indicators, playback of the process and support of annotation of the activity was used in the process. It was discovered that such 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 by the teachers did not match coding schemes 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 environments. In addition it should be observed that the coding scheme used by teachers did not necessitate consistency and reliability check (Strijbos et al 2006), as in research studies, since usually only one teacher performed the analysis of each one specific class.

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