On tools for analysis of collaborative problem solving

Nikolaos Avouris, Vassilis Komis, Georgios Fiotakis, Meletis Margaritis
University of Patras, GR-26500 Rio Patras, Greece
{ N.Avouris, Margaritis, Fiotakis } @ee.upatras.gr, komis@upatras.gr

Abstract

Analysis of collaborative problem solving involves analysis of dialogue and interaction, analysis of tasks and social roles through ethnographic and other field studies. Use of tools to facilitate this process can be very useful. In this paper we discuss first the key requirements of a new generation of interaction and collaboration analysis tools. We then present how these requirements have lead to the design of prototype tools, recently developed. These tools can relate and synchronize various streams of field data. An important characteristic of the tools is their support for a multi-layer structure of annotations of various levels of abstraction, through which the activity can be interpreted and presented.

1. Introduction

Tools to support interaction and collaboration analysis have been proposed in the field of human-computer interaction and learning technology design for many years now [4]. In the educational field, analysis of collaboration and interaction between the actors (students, tutors etc.), the artefacts and the environment is a process that can support understanding of learning, evaluate the educational result and support design of effective technology.

These analysis-support tools should (a) be independent of the analysis methodology used, (b) be able to accommodate and integrate multiple data formats, (c) be easy to use by the typical education research staff and analysts, (d) be inter-operable with external statistical analysis and other data processing tools, (e) produce results in various formats and (f) be flexible in supporting multiple views over the data, as these data can become the main repository of information for an educational research group and need often to be re-visited, under different research perspectives.

The design of tools that meet these requirements has been the focus of the research reported here. This research effort, has been inspired by aspects of human-computer interaction and user interface design. Since the main area of our applications is that of learning technology, we have developed during the last years a number of tools to support design and evaluation of interactive learning systems, [5], [1], [3] etc.

In this paper, we describe the functionality of a new integrated environment of analysis of group learning, which integrates multiple sources of behavioural data of multiple logging and monitoring devices, as well as a tool to annotate the solutions produced by *ModellingSpace*, a new collaborative modelling environment, discussed in [2]. Special attention has been put on scenarios of synchronous computer-supported collaborative learning, in which the actors are spatially dislocated, a factor which imposes additional complexity in the analysis task. In the following section the main features of the analysis environment are discussed, subsequently an example of use of the tools is provided, followed by a discussion on the implications of this research for our field and the perspectives of this effort.

2. Method and tools of analysis

The main functionality of the discussed analysis tools is related to the presentation and processing of logfiles and other field data, which have been produced during collaborative learning activities. These logfiles contain time stamped actions and text messages of partners engaged in modelling, in sequential order. The logfiles are based on the format of the exchanged control and chat messages and can be stored in XML. These files need to be viewed, commended and annotated by researchers. The tools discussed here, support this process. The activity can be reproduced using the playback tool that reconstructs group problem solving activity. Annotation is done, according to specific analysis models. An example is the OCAF scheme [1], particularly suitable for analysis of collaborative modelling activity.

The activity playback and solution annotation tool, shown in fig.1, is compatible to the ModellingSpace environment. This tool can playback the modelling activity step by step, thus reproducing the process through which a solution was created.

The analysis process also involves interpretation and annotation of the collected data, which means generation of aggregate data of interpretative nature. An additional tool, discussed in more detail in [3], supports creation of a multi-level structure that describes and interprets the logfile events. In fig. 2 the tool for creation and navigation of a multi-level model and associated stream media is shown. The three-level logfile is shown on the right, while the video window is shown on the left.

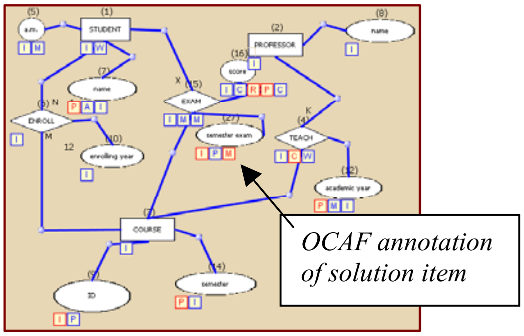

Figure 1. A jointly built model, annotated according to the OCAF scheme.

The original sequence of events contained in the logfile is shown as level 1 (*events level*) of this multilevel structure. A number of such events can be associated to an entry at the *task level 2*. Such an entry can have the following structure:< *ID, entry_type, comment* >

where *ID* is a unique identity of the entry, *type* is a classification of the entry according to a typology, defined by the researcher, followed by a textual *comment* or attributes that are relevant to this type of task entry. Examples of entries of this level are:" Student X inserts a link ", or "student Y contests the statement of Z".

In a similar manner the entries of the third level (*Goal level*) are also created. These are associated to entries of the previous task level. The entries of this level describe the activity at the strategy level as a sequence of interrelated goals of the actors involved.

An implication of this structure is that stream media, like video or audio can be related using this tool to the multi-level model of the activity and therefore the analyst can decide to view the activity from any level of abstraction he/she wishes, i.e. to play back the activity by driving a video stream from the task level or the goal level. This way the developed model of the activity is directly related to the recoded field events.

This possibility of viewing a process from various levels of abstraction is innovative, since it combines in a single environment the hierarchical analysis of activity, which has already been proposed and used by many frameworks of analysis, see Activity Theory, GOMS, HTA etc, to the sequential character of observational data.

3. Conclusions

In this paper we outlined the main features of new tools that facilitate analysis of complex field data of collaborative problem solving activities.

First, a playback and solution annotation tool permits re-construction of the problem solution and visualisation of the partners' contribution in the activity space.

In addition, a tool supporting multilevel analysis of logfiles in combination with snapshots of the solution or video has been presented and discussed. Through this, more abstract description of the activity can be produced and analysed at the group level.

In general, today there are many issues relating to collaborative learning that necessitate further research. So experimental tools are needed to support such studies. For this reason the analysis tools presented here, can be an invaluable means towards a better understanding of the issues related with collaborative learning.

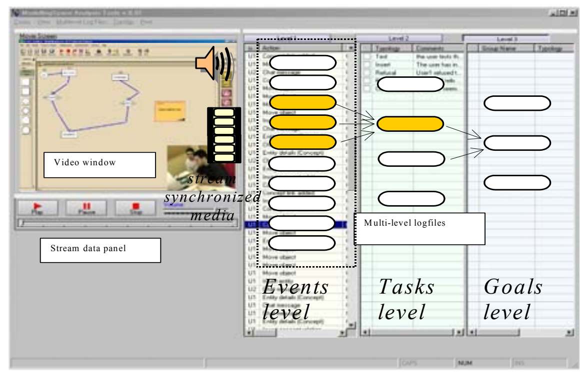

Figure 2. Navigation of multi-level log of collaborative problem solving activity

4. References*

1. Avouris N.M., Dimitracopoulou A., Komis V., On analysis of collaborative problem solving: An object-oriented approach, J. of Human Behavior Vol. 19, Issue 2, March 2003, pp. 147-167.
2. Avouris N., Margaritis M., Komis V., Melendez R., Saez A., ModellingSpace: Interaction Design and Architecture of a collaborative modelling environment, 6th CBLIS, Nicosia 2003.
3. Avouris N., Komis V., Margaritis M., Fiotakis G., Tools for Interaction and Collaboration Analysis of learning activities, 6th CBLIS, Nicosia 2003.
4. Dix A., Finlay J., Abowd G, Beale R., (1998), Human-Computer Interaction, Prentice Hall
5. Tselios N. K. & Avouris N. M., Cognitive Task Modelling for system design and evaluation of non-routine task domains, in E. Hollnagen (ed.) Handbook of Cognitive Task Design, Lawrence Erlbaum, pp. 307-332, 2003

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