

A methodological proposal to analyse interactions in online collaborative learning environments

Manuela Repetto

Doctorate on Educational and Cognitive Sciences
University Ca' Foscari, Venice, Italy
repetto@itd.cnr.it

Abstract. Interaction analysis within online educational contexts based on collaborative learning strategies requires a multidimensional model taking into account social, emotional and cognitive components. Starting from the assumption that only through correlation of these three dimensions it's possible to capture and understand the generative processes of learning in CSCL, this research is aimed at studying the existing analysis models (generally one- or bi-dimensional) and developing a new integrated model to investigate how these dimensions concur to the achievement of relevant learning within online educational contexts. The analysis is retrospective and carried out within several contexts.

Keywords: interaction analysis, online assessment, computer supported collaborative learning, technology enhanced learning.

1 Formulation of the research question

Online courses based on collaborative learning have gained the attention of several researchers from the educational field in the last two decades. There is evidence that these courses are crucial to promote sharing, management and building of knowledge. The collaborative strategy employed in these courses is based on the exchange of a high number of online asynchronous interactions among the participants within computer conferencing systems. According with the social constructivist approach, participants learn achieving collaborative activities aimed at the realisation of a common task like the solution of a problem, the analysis of a case study or the production of artefacts.

The proliferation of online courses has made compelling within the scientific community the development of design and validation methodologies aimed at distinguishing, within the huge offer of elearning solutions, those courses leading to successful learning outcomes. One of the most recent research trends within this topic concerns analysis of transcripts. As a matter of fact, computer-supported collaborative learning (CSCL) engenders high-level and very complex interactions among learners

which require, to be deeply investigated, an appropriate model enhancing content analysis of conference transcripts. This analysis should not only ensure individual assessment and self-regulation of learners, but achieve also the overall aim of exploring the quality of collaborative processes and the nature of learning within computer mediated educational environments. This research is aimed at offering, developing such a model, an innovative and effective contribution to the current knowledge on design and management of online courses.

2 Significant problems in this field of research

The major problem in the field of content analysis of CSCL environments is the lack of both effective and reliable techniques and of a theoretical framework capable of leading the building of techniques and the interpretation of results.

The coding system and procedures adopted for the analysis of transcripts should, on the one hand, ensure the classification of content in consistent and mutual exclusive categories and, on the other hand, should warrant reliability among different researchers. To accomplish these requirements the coding system shouldn't be too complex, while the unit of analysis should be univocal and clear.

Transcript analysis is often carried out mainly at a surface level, i.e. counting messages or calculating the threads length. With this type of analysis the risk lies in drawing rash conclusions like correlating positively a high number of words in a message with the quality of the content, or associating the high amount of messages sent by a participant with the success of the learning process. Furthermore, sample data are usually not so high: the number of participants and of conferences, or the amount of transcripts are not relevant for statistical purposes and for comparative studies.

The methodology adopted to study interactions should not provide a rough analysis of communication, but rather a deep analysis of social and cognitive dynamics, and of contextual factors affecting these processes. Researchers are not always aware of the complex social and cognitive dynamics characterising online collaborative activities, and this lack impacts also on educators' capability to assess learners. Systematic studies on this topic, based on structured and relevant sets of assumptions, ideas and concepts, and sustained by a unique theoretical perspective, are needed, since many studies connect in a unique model a mixture of techniques inspired by different and incompatible paradigms. If the constructivist perspective is adopted, for instance, the transcript analysis technique should consider interactions dynamically in terms of collaborative construction of knowledge, and not prescriptively as definite and countable behavioural data. Moreover, models tailored for analysis of cognitive aspects usually capture only external cognitive behaviours, without considering internal and implicit processes.

Another problem lies in the methodological approach underlying most models: approaches are usually exclusively qualitative or only quantitative, even if it's recognised that within social and educational research qualitative methods have to be consciously combined with quantitative methods, according with a "mixed approach".

3 Outline of the current knowledge of the problem domain

The exploratory nature characterising the present studies of the topic described above is probably due to the immaturity of research in this field, or to the lack of reliability of the coding systems elaborated so far. The pioneer work of Henri [3] generated a lot of studies, but nobody replicated either that model and its updated versions, or the alternative models which have been developed by several researchers in recent years. Moreover, most studies are mainly descriptive, while only a few adopt an experimental design.

The majority models are one-dimensional, detecting mainly participation. Even in so called multidimensional models, the main dimension investigated is social presence, while other relevant dimensions like the cognitive or the affective ones are not deeply analysed. Rourke et al [4], for instance, focus only on one element of the model, social presence, providing a template for assessing it through content analysis of transcripts and testing the efficacy of this tool.

The most well-known multi-dimensional models for content analysis developed so far adhere to one of two distinct paradigms.

The aforementioned Henri's model is grounded according with a cognitivistic vision of learning which emphasizes the individual aspects of knowledge. The multidimensional model developed by Garrison et al [1] instead, aimed at guiding the use of CSCL to support critical thinking, and that of Gunawardena et al [2], which have built a five-phase tool to analyse knowledge construction, follow social constructivist theories and thus consider learning as socially grounded.

4 Preliminary ideas, the proposed approach and the results achieved so far

The main epistemological assumption of this research project is that learning results from the interaction of three core components: the cognitive dimension, the social dimension and the affective one. These dimensions are being investigated both separately – trying to understand dynamics at cognitive, social and emotional level – and jointly, according with an holistic approach, in order to detect possible correlations or relations of any other kind. The analysis is carried out both at individual and at group level (Fig. 1). Potential surveys will investigate, concerning social dimension, if and to what degree relational dynamics triggered from the assumption of implicit – or explicit – roles or attitudes are crucial for the general affective climate and for knowledge building of individual and groups. At a cognitive level, the possible effects of building and negotiation of meaning on socio-affective dynamics will be investigated as well. With regard to the affective dimension, it will be examined to what extent specific emotional and motivational states affect cognitive processes.

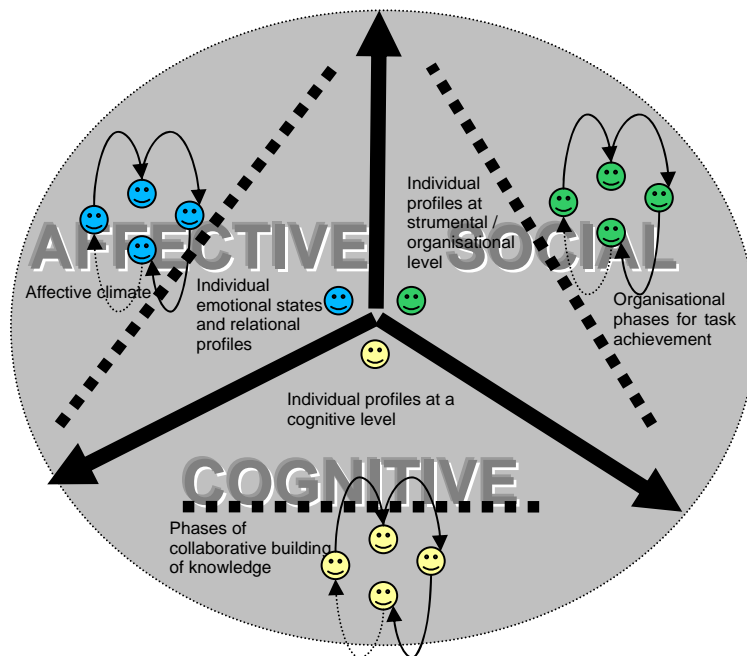


Fig. 1. A representation of the three dimensions of the model investigated at an individual and group level.

Starting from the investigated phenomena, the main tendencies, patterns and configurations will be detected to better understand which elements and conditions render these situations virtuous or critical for individual and collective learning. At an individual level, a range of possible profiles assumed by learners will be sketched; at collective level, typical phases (organisational, affective and cognitive) crossed by groups during a series of collaborative activities will be identified.

These information will take into account also data gathered from the analysis of tutor's interaction with learners, in order to identify situations in which he/her has played a crucial role on cognitive, social and affective dynamics of learners.

Investigation of these three dimensions requires an integrated multidimensional model for the analysis of conferencing transcripts, aimed at detecting to what extent these components concur in triggering relevant learning within computer mediated environments. The analysis is retrospective and is carried out in various contexts (higher education, doctorate school, pre-service teacher training, and continuous professional development).

Categories and indicators for analyzing the conferencing transcripts have been identified through a recursive process, combining a data-driven approach with a theory-driven approach. Firstly indicators were derived from those used in literature

on interaction analysis or adapted from scholarship on interaction in traditional face to face learning contexts. These indicators have been assigned to broad categories. Secondly, additional indicators were inferred from readings of the transcripts. Further work is undergoing to verify consistence of both categories and indicators. The next step will be detecting these indicators during the analysis of conferencing transcripts, which are structured in weeklong and self-contained discussions focusing on a specific topic, through the development of a *segmentation procedure* [5] and the adoption of a coding scheme based on the established categories and indicators. The unit of analysis of these transcripts will be sentences meaningful in themselves that will be imported in the analysis tool Atlas-ti. This tool will allow the segmentation process according with the coding scheme. The analysis will be carried out by two independent coders to check and ensure inter-rater reliability. Whereas reliability will be too low, categories and related indicators will be reviewed.

The model developed so far includes three components (cognitive, social and affective), organised in 5 categories and about 30 indicators¹. A self-assessment questionnaire consisting of several items scored on a five-point Likert-type scale has been developed to detect the same process indicators investigated in transcripts. This questionnaire, if administered at the end of each learning activity, stimulates meta-reflection of learners and promotes self-regulation of learning. If used by researchers and crossed with results obtained through transcript analysis, it provides further information for aspects more latent or implicit. Till now, a wide sample of about 300 learners have compiled this questionnaire, in order to test the proposed methodology with a wide sample of groups of participants; nevertheless, this model can be replicated with few groups of people, even by the tutor herself, in a more cost-effective way.

5 Sketch of the applied research methodology

The methodological approach applied to the analysis of transcripts is both quantitative and qualitative. The former is based on the grounded theory and consists on codification through the software Atlas-ti and statistical elaboration of data with SPSS, combined with interaction analysis carried out through SNA tools (Social Network Analysis). The latter relies on a parallel analysis process leaded through the ethnographical method: a subjective judgement for each category formulated on the basis of the accurate reading of transcripts will be given on a five level-scale basis (from null to excellent). This two-fold analysis process is triangulated with learners' subjective perceptions of cognitive, social and emotional aspects - obtained through the questionnaire - and with objective measures of the learning outcomes (the individual and collective products and final grades).

¹ Two categories correspond to the social and to the emotional dimensions; the other three represent the articulation of the cognitive one in three subdimensions (individual learning, metacognition and construction of knowledge). The indicators are particular attitudes that can be detected through transcript analysis (i.e. correctness of concepts or the argumentation of one's personal point of view are indicators for individual learning).

In the crucial phases of the research, data obtained with different tools will be integrated developing equivalence tables among results gained with qualitative methods and those attained with quantitative techniques. Finally, data describing each dimension will be aggregated through techniques of multivariate analysis in order to determine how each indicator influences the dimension to which it belongs and to what extent the three explored dimensions are correlated in the generation of relevant learning.

Hence, part of the research will be carried out on an empirical level according with an experimental perspective, through techniques gathering highly structured data organised in matrices and analysed with statistical elaborations; another part of the research will instead realised through an hermeneutic approach, by means of qualitative techniques like discourse analysis and conversational analyses, which capture not quantifiable either formalisable aspects.

6 Description of the Ph.D. project's contribution to the problem solution

This research should have implications and benefits not only for researchers, but even for course developers, instructors, tutors and for the students themselves.

The model of analysis under development can be used easily by educators, who don't need to be trained to use it; they will be offered an innovative approach for formative and summative assessment of learners. Tutors and instructors will be supported with a set of criteria through which monitoring and detecting critical situations and drawing suggestions on how to manage them. These criteria will enhance them to opportunely intervene on various levels and to regulate interaction in order to improve the use of high level cognitive abilities, to increase participation and collaboration processes, and to maintain an optimal affective climate.

At the same time, this model could represent a reliable scientific tool for online courses design. Considerations emerging from the research results on the profiles of individuals and on the dynamic configurations that groups can take in the different steps of a collaborative work, may support the planning of effective learning activities and orient the formation of heterogeneous and well-balanced groups.

Assessment results may be interpreted also from learners, who can improve their metareflection capabilities and, if timely informed during the course, are able to self-regulate constructively learning.

During the research project strengths and weaknesses of all the previous relevant techniques and methods will be taken into account as a basis for the development of the new model of analysis.

With respect to the contribution for progress in the educational sciences, the application of this integrated model to a wide sample of discussion transcripts is an attempt to explain in which conditions and to what degree the investigated components of the model concur in generating relevant learning.

The remaining work to be done is huge and there will be many obstacles to overcome; however the results achieved so far are encouraging.

7 How the suggested solution is different, new, or better as compared to existing approaches

The mixed approach adopted in this research project, as a unique perspective unifying qualitative and quantitative knowledge, is an optimum within educational research. According with the foundations of contemporary epistemology, the qualitative knowledge precedes the quantitative one, orienting it and verifying its results.

In the same way, the approach adopted within this research enhances investigation of educational interactions in their own complexity. Unlike most other existing approaches, the suggested solution consider the relative importance of each indicator on the dimension to which it belongs, and even the relations between different dimensions, providing empirical evidence with the analysed data. Major importance is given to the affective dimension, an aspect that, in spite of the spreading of last research on emotions and motivational aspects, is usually neglected or underrated in the relevant literature on interaction analysis.

Thanks to this approach it's possible not only to have an effective tool to monitor and assess learners – the majority of the present solutions address this issue - but even to explore at a deeper level the nature of learning within virtual learning environments.

Furthermore, the present research project addresses not only a specific target of learners or a single course, but several ones. The selection of wide samples of data from a rich database of courses is an added value derived from the opportunity to attend - during this research and also previously – an high number of courses at different titles (as a student, as a tutor, as a coordinator of tutors, as a designer of courses), and to develop a deep knowledge of interaction occurred there.

References

1. Garrison, D.R., Anderson, T., Archer, W.: Critical Inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*. 2(2-3), pp.87--105 (2000)
2. Gunawardena, C., Lowe, C., Anderson, T.: Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research*, 17 (4), pp.397--431 (1997)
3. Henri, F.: Computer conferencing and content analysis. In: Kaye A. (Ed.) *Collaborative learning through computer conferencing: The Najaden papers*, (pp.117--136). Springer-Verlag, London (1991)
4. Rourke, L., Anderson, T., Archer, W., Garrison, D.R.: Assessing social presence in asynchronous, text-based computer conferences. *Journal of Distance Education*, 14 (3), pp.51--70 (2004)
5. Strijbos, J., Martens, R. L., Prins, F. J., Jochems, W.M.G: Content analysis: What are they talking about? *Computers & Education*, 46, pp. 29--48 (2006)