

# Analysing the quality of collaboration in task-oriented computer-mediated interactions: introduction to the workshop proceedings

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## 1 Introduction

These proceedings are composed of extended versions of papers and discussion reports from a workshop on “Analysing the quality of collaboration in task-oriented computer-mediated interactions” which took place on the 18th of May 2010, in the framework of the COOP 2010 conference. With the growing importance of technology mediation for group work and learning, developing methods for assessing the quality of collaboration is central to research carried out within both Computer Supported Cooperative Work (CSCW) and Computer Supported Collaborative Learning (CSCL). This workshop aimed to bring together researchers from these two fields, working in cognitive, social and computational sciences on understanding collaborative activities. The workshop was co-

organised by Françoise Détienne, Michael Baker, Jean-Marie Burkhardt and Hans Spada (University of Freiburg).

## 2 Motivation

The aim of the workshop was to study theories, models and analysis techniques that enable us to understand the quality of collaborative activity in task-oriented computer-mediated interactions. In this context, the term ‘quality’ can be understood in descriptive terms (identifying and discriminating the intrinsic properties of collaboration) and/or in a normative sense (identifying what makes ‘good’ or less good collaboration, considered *sui generis*). These visions of quality can be complementary; and exploring this would require elaborating deep models of the processes of collaboration, articulated with assessment of the degree of achievement of collaboration goals in specific situations, and understanding of productive and creative potentialities of dialogue. Research originating across a broad variety of disciplines in social, cognitive and computational sciences can contribute to these theoretical and methodological aims, within a perspective of making constructive interventions in concrete collaborative work situations. Application domains range from various workplace situations (companies, hospitals, training institutes, schools, ...) with varied tasks (collaborative design, learning, decision-making, ...). Methodological approaches include qualitative-quantitative interaction and group-work analysis, trace-log analysis, interviews, computational modelling, participant observation, workplace studies of technological mediation and transfer, usability studies, ...

Across these various fields there are several reasons why the study of quality of collaboration is important:

- Establishing correlations between quality of collaboration and its outcomes (quality of solution, learning effects, quality of products, adequacy with respect to design constraints, creativity and innovation of products...);
- Establishing correlations between characteristics of tools that mediate collective action and quality of collaboration;
- Devising methods for training groups, in the workplace, in educational institutions, for more effectively collaborating;
- Enabling participants in group work and learning to become reflexively aware of the nature and quality of their participation and collaboration.

Aspects of this kind (the list is non-exhaustive) contribute more generally to the elaboration of theories and models of collaboration as well as to devising methods for evaluating computer-supported cooperative/collaborative work and learning.

### 3 Collaboration processes in problem solving oriented activities

Research focused on the analysis of collaborative activities in task-oriented situations (e.g., collaborative design, see for example, Olson, Olson, Carter & Storrosten, 1992; Stempfle & Badke-Schaub, 2002; Burkhardt, Détienne, Moutsingua-Mpaga, Perron, Leclercq & Safin, 2008; Détienne, Burkhardt, Hébert & Perron, 2008) has highlighted collaborative processes along different dimensions. They can be classified according to their orientation toward design-task processes, group processes or communication processes.

Firstly, collaboration concerns the activities related to the evolution of tasks, e.g. design activities (elaboration, enhancements of solutions and of alternative solutions) and evaluation activities, supported by argumentation and negotiation mechanisms. These content-oriented activities reveal how the group resolves the task at hand by sharing and co-elaborating knowledge concerning the task resolution, by confronting participants' different perspectives, and by converging towards negotiated solutions.

Secondly, collaboration concerns group management activities such as project management and coordination activities, e.g., allocation and planning of tasks; and meeting management activities, e.g., ordering, postponing of topics in the meeting. These process-oriented mechanisms ensure the management of tasks interdependencies, which is highly important in a tightly coupled task such as design.

Thirdly, communication processes are highly important to ensure the construction of a common reference by the group of collaborators. The establishment of common ground is a collaborative process (Clark & Brennan, 1991) by which the participants mutually establish what they know so that task-oriented activities can proceed. Grounding is linked to sharing of information through the representation of the environment and the artefact, the dialogue, and the supposed "pre-existing" shared knowledge. This activity ensures inter-comprehension and construction of shared or compatible representations of the current state of the problem, solutions, plans, design rules and more general design knowledge.

Finally, recent research on collaboration processes (Baker, Détienne, Lund & Séjourné, 2003; Barcellini, Détienne, Burkhardt & Sack, 2008) considers the roles of participants according to communication, group management and task management and the balance between these roles as an important aspect in collaboration.

## 4 Analysis of collaboration and groupware evaluation in CSCW

Although most authors in CSCW generally agree upon the importance of these various aspects of collaboration (even if research works may have specific focuses), the notion of quality of collaboration remains most often quite implicit.

Regarding user studies, there are many methods that rely on different data collection and analysis techniques: they can be based on computers logs, interactions between participants (coding methods or ethno-methodological methods), or interviews. The indicators used to analyse collaboration processes are often focused on quantifying fine-grained interactions. An example, as given in a recent review by Hornbæk (2006), they concern the measure of “communication effort”: number of speakers’ turns; number of words spoken; number of interruptions, amount of grounding questions. However this does not give an indication of how well the group collaborated. Furthermore, user-based methods to assess collaboration concentrate only on one or two dimensions leaving aside a more global view of collaboration: for example, verbal and gestural communication to assess the grounding processes. The balance/symmetry of individual contributions are rarely considered, although they reflect complementary aspects of collaboration assessment. Ethno-methodological methods are often most sensitive to approach quality of collaboration on the basis of qualitative analyses.

Regarding groupware evaluation methods, their focus remains clearly on task modelling (e.g., Tromp, Steed & Wilson, 2003), i.e. eliciting goals and actions required for users to interact together and not on the collaboration processes and their quality *per se*. Some usability inspection methods (e.g., Pinelle, Gutwin & Greenberg, 2003) consider a large spectrum of collaboration aspects.

As one important issue in CSCW is to understand to which extent technology mediation affects or supports collaboration processes, we propose that one key question is to understand what differentiates good from poor collaboration. It is an important step to understand on one side the relationship between collaboration quality and group performance or efficiency and on the other side the effects of technology affordances on these both aspects.

In the related field of CSCL<sup>1</sup>, the analysis of the process of collaboration is also a central topic of research and the notion of quality of collaboration has become an important issue.

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<sup>1</sup> This field has its own journal, the *International Journal of Computer-Supported Collaborative Learning* (<http://ijcscl.org/>) and biennial international conference (<http://www.isls.org/cscl.html> ; e.g. <http://www.isls.org/CSCL2009/welcome.htm>), both organized under the aegis of the International Society for the Learning Sciences (<http://www.isls.org/about.html>).

## 5 Collaboration processes in learning oriented activities and the notion of quality of collaboration

Research on collaborative learning emerged as a field from the 1980s onwards, from two related research trends. Firstly, researchers working in ‘mainstream’ cognitive psychology and information-processing models of individual reasoning, problem-solving and learning, began to turn their attention to learning in groups, largely motivated by the possibility and necessity of understanding how students worked together with and around computers (see, e.g. the synthesis in Dillenbourg, Baker, Blaye & O’Malley, 1996). A second strand concerned the attempt to extend Piaget’s theories of development, again, largely focussed on the individual, to learning in social interaction. This gave rise to the theory of socio-cognitive conflict (Doise & Mugny, 1984). Across these approaches, the 1990s saw the recognition that in order to understand the conditions for efficient collaborative learning, beyond relations between individuals’ characteristics, and features of the task, it was necessary to analyse the nature of the interactions between students, to identify productive or constructive forms of interaction that could explain learning effects. The phenomena identified and analysed included self-and-other explanation, grounding that went beyond what was strictly required for mutual understanding, forms of mutual regulation, and various types of constructive resolutions of argumentative interactions. More generally, a consensus has emerged in this field on the nature of collaboration as a continued and synchronous attempt to construct and maintain a shared representation of the problem to be solved (Teasley & Roschelle, 1993; Baker, 1995; Dillenbourg, 1999).

In other terms, collaboration is seen as a type of “super-cooperation”, probably only occurring in isolated phases of group work, during which students go beyond aligning and concatenating individual solutions, to genuinely co-constructing them, on the basis of a shared understanding of what the problem is. The analytical problem is to identify when such collaboration occurs, and it appears that it can take several different forms, within a “knowledge negotiation” process (Baker, 1994; Baker, 2002). In this context, the quality of collaboration can be seen as relating to the extent that, and the way that, students ‘take up’, reformulate and elaborate their partners’ contributions, rather than elaborating their own thinking ‘in parallel’. The space of collaboration, of greater or lesser quality, can also be circumscribed by identifying the reasons why “smart groups fail” (Barron, 2003), basically, because whilst high-quality solutions may be proposed within some groups, they are often not collectively recognised, taken up and elaborated.

In sum, collaborative learning research has gravitated towards trying to understand the nature of collaboration, its different manifestations and quality, with the specific goal of relating it to learning outcomes. There have been calls

(Crook, 1994) of growing insistence and recognition for extending this almost exclusive focus on measures of the size of the learning effect, towards considering collaboration in learning as a specific socio-relational experience that may be more or less personally rewarding.

Finally, if we know what ‘good’ and ‘bad’ collaboration for learning are, it might be possible to instruct students in how to collaborate, and thus validate the model of collaboration. Thus Mercer (1994) has demonstrated precisely this, with respect to a set of ‘ground rules’ of collaborative conversation, which, when put into use by students, lead to superior learning effects than without such instruction.

A central issue in CSCL is also how to design communication interfaces and shared learning task spaces that ‘structure’ or ‘script’ collaboration in ways that are designed to be optimal for learning (see e.g. Fischer et al., 2007, for a collection of works on this theme). Collaboration can be structured in several ways, for example by constraining the set of available speech acts (Baker & Lund, 1997), by imposing a strict task sequence, by providing specific semiotic means of expression, such as argumentation dialogue diagrams (see Andriessen, Baker & Suthers, 2003). There has recently been a debate in this field about ‘over-scripting’ (Dillenbourg, 2002), or rather as to just how much collaboration can and should be scripted, so as to favour optimal forms of collaboration yet without preventing the essential creativity of dialogue.

Evaluating the quality of collaboration is another central issue. The Spada rating scheme (Spada, Meier, Rummel & Hauser, 2005) is certainly the most representative of recent effort made to evaluate collaboration and its quality. It has been developed to compare and assess collaboration in collaborative learning tasks, with respect to various learning methods or technical support. A recent review of the literature (Voyiatzaki, Meier, Kahrmanis, Rummel, Spada & Avouris, 2008) provides theoretical arguments to consider five aspects (communication, joint information processing, coordination, reciprocal interaction, individual task orientation) as central for successful collaboration under the conditions of video-mediated communication and complementary expertise.

## 6 Organisation of the proceedings

The one-day workshop was organised into paper sessions in the morning, and discussion groups in the afternoon, followed by verbal reports to all attendees and the writing of discussion reports for the proceedings. The extended version of the papers in these proceedings are organised around the three themes of the workshop sessions. These are followed by reports of discussion groups which debated on the workshop themes.

### **Theme 1: From qualitative to quantitative dimensions of collaboration**

1. A descriptive model of collaboration to underpin a collaboration profiling methodology. *Harshada Patel, Michael Pettitt, Scott Hansen, John Wilson*
2. Study of correlations between logfile based metrics of interaction and the quality of synchronous collaboration. *Georgios Kahrmanis, Irene-Angelica Chounta, Nikolaos Avouris*
3. Quantitative assessment of collaboration. *Stéphanie Buisine*
4. Quality of collaboration in a distant collaborative architectural educational setting. *Stéphane Safin, Aurélie Verschuere, Jean-Marie Burkhardt, Françoise Détienne, Anne-Marie Hébert*

### **Theme 2: Collaborative processes in groups**

5. ‘Slow’ Collaboration: Some uses of vagueness, hesitation and delay in design collaborations. *Janet McDonnell*
6. Close collaboration, dialogical thinking and affective regulation. *Michael Baker*
7. Collaboration as constructive interaction and the jigsaw method as its enhancer. *Hajime Shirouzu*
8. Understanding collaboration in team design task-oriented interactions. *Chrysi Rapanta*

### **Theme 3: Collaboration in flexible open communities**

9. Virtual learning communities and groups dynamics in the overcoming of obstacles. *Christophe Gentil, Marie-Laure Betbeder, Jacques Beziat, Eric Bruillard*
10. Assessing Writing and Collaboration in Learning: Methodological Issues. *Philippe Dessus, Stefan Trausan-Matu, Sonia Mandin, Traian Rebedea, Virginie Zampa, Mihai Dascalu, Emmanuelle Villiot-Leclercq*
11. Assessing the quality of collaboration in open, online, calculus help forums. *Carla van de Sande*
12. Task-oriented collaboration: not just what is inside the task, but what the task is inside of. *Charles Crook*

### **Discussion reports**

13. Report on discussion group 1. *Stéphane Safin, Jean-Marie Burkhardt, Stéphanie Buisine, Giorgos Kahrmanis, François Charoy*

14. Report on discussion group 2. *Michael Baker, Janet McDonnell, Chrysi Rapanta, Hajime Shirouzu*
15. Report on discussion group 3. *Charles Crook, Françoise Détienne, Philippe Dessus, Christophe Gentil, Carla van de Sande*

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