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IMPLICATIONS OF A COOPERATIVE MODEL FOR THE DESIGN OF COLLABORATIVE TOOLS

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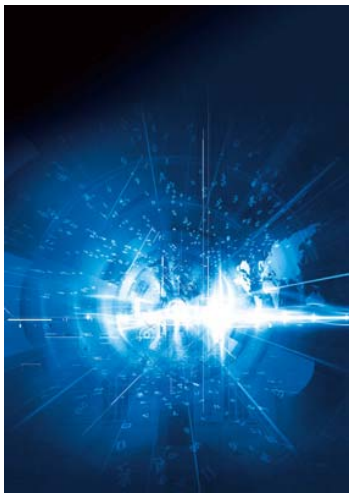

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Implications of a cooperative model for the design of collaborative tools

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Abstract: Design choices for collaborative tools are often made on a technical or arbitrary basis. In some cases, such choices have a pedagogical justification; we posit that a design rationale appealing to theoretical concepts in cognitive and pedagogical sciences is sounder than one that makes consensus choices based on availability of technology. We explain how a cognitive model of cooperation helped shape our decisions for the design of a collaborative text editor. We established links between alternative designs and the forms of cooperation that were thus rendered possible (as defined by this model). As research questions were centered on the forms of cooperation which were likely to emerge, we were eager to minimize the constraints imposed by the tool. Our view is that there is a strong relationship between cognitive models of interaction and the collaborative properties of CSCL tools that can be wisely exploited when designing such tools.

Introduction

One research focus in CSCL is centered on the learning and interactions that are the result of using collaborative tools (e.g., Baker & Lund, 1997). A second approach, related to the field of human-computer interaction concerns itself with observing situations of CSCL in order to improve the tools (e.g., Olson, Olson, Carter, & Storrosten, 1992). These two attitudes are not mutually exclusive and frequently complement each other. We take the position that, although the various forms of interaction observed are not imposed by the collaborative tools used, these tools nevertheless exert a strong influence on the resulting interactions (Guzdial, 1997; Lund, 2004; De Vries, Lund, & Baker, 2002; Decortis, Rizzo, & Saudelli, 2003). It is therefore unwise to discount the effect of these tools or their instrumentation (Rabardel, 2003), even when performing a study where this effect is not the primary center of attention.

Situation

In the course of the CICLOPE (1) study, we were interested in the relations between factors that influence collaboration and models of collaborative problem solving (Lund, Rossetti & Metz, 2006). The format of the study was to have dyads compose a procedural text for folding an origami from a video of the origami construction; the collaborative environment they worked in provided an (individual) video player, a chat area and a shared text editor. This led us to design a shared text editor that would be appropriate for the research questions under consideration. In particular, we wanted to analyze the collaboration within a dyad in terms of a model of collaborative problem solving (Baker, 2002).

Design choices for collaborative tools

Let us consider two forms of a shared text editor – among many others (Sun, Jia, Zhang, Yang, & Chen, 1998; Handley & Crowcroft, 1997): the first works with a turn-taking token (only one person at a time has the token and its associated writing privileges); the second allows all participants to write at the same time, behaving like a computer with multiple mice and keyboards (and by extension, one cursor per keyboard in the text editor). What would the difference between these two text editors be? Which should be used (and more pragmatically, implemented by the designers of the collaborative environment)? This decision could be purely technological (the first is easier to code) or arbitrary (the second seems more interesting).

One of the functions of the collaborative argumentative graph editor, DREW (2) (Corbel, Girardot, & Jaillon, 2002; Corbel et al., 2003) is *scrunching*, which graphically highlights the fact that a claim or argument is a subject of disagreement; this function was motivated by pedagogical reasons (Baker, Quignard, Lund, & van Amelsvoort, 2002): isolating controversial claims centers the discussion on the underlying reasons for the disagreement; this unravels the notions which come into play and favours progression towards a common solution. In a similar vein, we judge it preferable to motivate our choice for the shared text editor with a pedagogical or cognitive reason, a better basis for making such a decision than an abitrary or techlogical justification.

Basing design choices on a cognitive model

The characterization of collective interactions as specified by Baker (2002) describes three dimensions: the s*ymmetry* of the roles taken on by the partners during their interaction, the degree of publicly expressed *agreement* on the different aspects of the cooperative activity of problem solving, and *alignment,* the degree to which the partners are "in phase" in terms of mutual comprehension and phases of their cooperative problem solving. We propose a description of collaborative tools based on these dimensions; thus, a tool can impose, forbid, favor or hinder a given form of interaction. This description distinguishes itself from Clark and Brennan's (1991) categorisation of communicative media in that they describe *a posteriori* properties of the media, whereas we relate these properties (and others) to their *a priori* influence on collective interactions, transitively attributing the dimensions of interaction to the tools themselves.

In the case of the shared text editor, its first form imposes an asymmetric collaboration wherein only one person at a time can take on the *scribe* role. The second form, however, is agnostic with regard to symmetry: all the participants may contribute at the same time or, if they prefer, they can organize themselves in an asymmetric manner. Discussing the tool in these terms during the CICLOPE study allowed us to highlight the constraints of the first form of text editor and lead us to choose the latter (Rossetti, 2006). This choice was directly linked to the research questions referred to above: we were anxious to provide the dyads with as much leeway as possible along Baker's (2002) dimensions. Other research questions or goals would probably lead to other design choices – a particular pedagogical scenario might want to enforce turn-taking and limit use of a shared text editor to allow only asymmetry.

Similar considerations led us to reject using color to distinguish between contributions from the various participants, as we wanted the shared text editor to be a consensual co-constructed artifact where the notion of agreement was implicit, forcing disagreement to be either ignored or explicitly raised in the other communication channel of the study, the chat. This point was apparently justified although it is not clear whether disagreement stemmed from the lack of ownership of sub-parts of the shared text editor or from multiple cursors allowing non-aligned dyads to pursue their ideas individually without prior consultation:

> We notice much more argumentation on the content of the instructions [with the use of two text cursors instead of one]. Perhaps the presence of two cursors in the text editor allowed participants to write what they wanted without first expressing themselves in the chat module and this created disagreement. (Lund et al., 2006, p. 25, [translated from the original French]),

Another form of collaborative text editor allows participants to acquire a lock on an individual paragraph, edit it in private and then publish it to the other participants; while this provides technological advantages in terms of ease of implementation, we agreed that there would be too great a time lapse between the intitiation of an edition and its publication and that real-time propagation of changes would provide better alignment.

The chat was not modified, as it is a commonly found computer-mediated tool. It can however be discussed in terms of alignment, agreement and symmetry. The delay between the initiation of a message and sending it is again problematic for alignment. In the general case, any form of collaborative tool that allows private modifications to be initiated and only published at a later date (*reviseability* as defined by Clark and Brennan (1991)) augments the alignment problem which is inherent to computer-mediated cooperation. In the chat, disagreement is explicit, as utterance authors are clearly labeled; this raises interesting questions in the case of tools that are not only communicative media but co-constructed artifacts such as shared text editors and whiteboards: how does the explicit authorship of objects affect the cooperative process, both generally and in specific terms of agreement? Finally, while it is trivially true that all participants can write in the chat at the same time (*simultaneity*, c.f., Clark and Brennan, 1991), imposing no constraints on symmetry, in the general case it is technologically difficult (Sun et al., 1998) to allow this. Lund et al. (2006) note the link between ability to edit concurrently and disagreement (c.f. above), which would suggest that we should be cautious during the design process when deciding whether a tool should allow concurrent edition.

Conclusion

This discussion based on the characterization of collective interactions could be formalized and lead to an analysis method of collaborative tools. This analysis would determine, *a priori* the collaborative properties of a tool and would serve to predict the potential influence of a technological choice on the interactions mediated by this tool, thus providing us with a justification for technological choices and working hypotheses on the usage of the resulting tool.

Naturally, there is no reason to limit ourselves to the model proposed by Baker (2002). This model served as a basis for our work because it was later used to analyze computer-mediated traces of a collaborative task (Lund et al., 2006). We expect that other models will also give rise to properties of collaborative tools, forming a global basis for making and justifying design choices through theoretical concepts. If we estabilish a hierarchy in the ontology of design rationales, theoretical justifications would be the most important and only be superceded by technological ones in the cases where one alternative is impossible.

Endnotes

(1) The CICLOPE (Occulometry for the characterization of collaborative activity during distance learning) project was financed by the University of Lyon, France in 2005-2006.

(2) DREW (Dialogical Reasoning Educational Website) was designed and developed during the European project SCALE, (Internet-based intelligent tool to Support Collaborative Argumentation-based LEarning in secondary schools, 2001-2004), 5th Framework, IST (Internet Societies Technologies).

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