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# Group awareness tools for learning: Current and future directions

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ABSTRACT

Group awareness has become an important concept since it was introduced into the field of computer-supported collaborative learning. This paper discusses current trends and future directions in this research field. It is argued that the development and implementation of tools should be complemented by systematic explorations into the mechanisms that moderate the relationship between group awareness and learning. It is suggested that variations in tool design features are a starting point for furthering our understanding of the processes involved in group awareness. Based on the contributions in this special issue, eight areas for future empirical investigations are identified. The paper concludes with some theoretical considerations on the nature of group awareness.



## 1. Introduction

When the term "awareness" was coined some 20 years ago, many scholars in the field of computer-supported collaborative work (CSCW) held that interacting via computers was lacking the richness of natural, unmediated interaction. In CSCW research, "awareness" became an umbrella term to express precisely those qualities that were lacking in computer-mediated environments; in other words, awareness was defined *ex negativo*. Consequently, early technological solutions to provide awareness were trying to recreate the gold standard of face-to-face environments, e.g. through the use of video cameras that captured how work activities unfolded across space. In subsequent years, the notion of awareness was extended considerably, and while Gutwin and Greenberg (1995) were among the first to theorize about social aspects of awareness, CSCW research and development was still bound to the idea of facilitating the perception of spatially grounded activities (seeing who is around; seeing who is located in real or virtual space; seeing what others are doing).

For large parts of the last 20 years, the notion of awareness has been confined to the area of CSCW. However, about 5 years ago the concept was begun to be explored by a number of research groups in the field of computer-supported collaborative learning (CSCL) as well. Along with the move from cooperative work to collaborative learning came a number of different ideas on what awareness is about. First of all, providing environmental or spatial cues plays a much smaller role in the relevant CSCL literature. Rather, awareness tools focus on social aspects, i.e. on information that is inextricably bound to other persons (hence the label of "group awareness"). Secondly, while "classical" awareness is often limited to observable phenomena (presence, activities), group awareness in CSCL has a much stronger emphasis on cognitive or social categories that are not directly observable (e.g. knowledge or attitudes; Buder & Bodemer, 2008). Thirdly, along with the shift from observable to non-observable categories, face-to-face interaction is no longer the gold standard to be achieved. In fact, most group awareness solutions in CSCL focus on qualities of interaction that are difficult or even impossible to be achieved in face-to-face contexts, thereby providing an added value to computer-mediated collaboration (Buder, 2007). This special issue bears witness to these recent developments in CSCL, and it provides many interesting insights into the question of whether supporting group awareness gives rise to better collaborative learning in terms of processes and outcomes.

The contributions in this issue all focus on awareness about cognitive and/or social variables, and they all explore the relationship between awareness and learning. Nonetheless, they represent a wide array of different scenarios, thereby exemplifying the broad scope of group awareness applications. For instance, the learning outcomes that were addressed range from individual learning performance (knowledge tests) to collaboratively constructed products (essays). The processes investigated in these studies cover very different learner activities, among them patterns of verbal communication, manipulations of graphical elements in interaction, and frequencies of awareness tool use. Finally, each of the tools described in this special issue differs in what precisely is made aware. In the study of Bodemer (2011), participants were made aware of their collaborators' situated use of knowledge pieces. Subjects in the study of Dehler, Bodemer, Buder, and Hesse (2011) were made aware of self-assessments of their learning

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partners in terms of the degree of understanding of learning materials. Sangin, Molinari, Nüssli, and Dillenbourg (2011) explored awareness about objective levels of partner performance from a knowledge test. The tool developed by Janssen, Erkens, and Kirschner (2011) provides awareness about the overall writing activity levels of participants. And the study by Phielix, Prins, Kirschner, Erkens, and Jaspers (2011) addresses awareness about social and cognitive categories like the friendliness or the productivity of collaborators. Despite all the differences in the scenarios involved, these studies have all shown a relationship between group awareness and indicators of learning, and they add to an impressive list of other studies that have found such a relationship in the past. While the diversity of settings and tools makes it exceedingly difficult to provide a comprehensive and clear-cut definition of group awareness, it also underlines the enormous potential of group awareness support systems for computer-supported collaborative learning.

As the field matures, it can be expected that more and more studies will show the benefits of group awareness technologies for collaborative learning, both in laboratory settings and in educational practice. However, apart from developing ever new tools to support awareness, we should also begin to systematically explore the underlying mechanisms that impact the relationship between awareness and learning outcomes. The paper by Fransen, Kirschner, and Erkens (2011) provides many important insights into the psychological variables that are related to group awareness, but it does not directly address the role of technology in this process. What we need, then, is an understanding of the potentially complex interactions between group features, design features, task features, learning processes, and learning outcomes. The present contribution is an attempt to integrate some of the findings from this special issue and from other sources in order to provide building blocks towards a deeper understanding of why and how group awareness can foster learning. With a particular emphasis on design features, it tries to identify relevant research questions that deserve to be tackled in dedicated empirical investigations.

The next sections of this paper are organized around a distinction made by Schmidt (2002) in his review on CSCW awareness research. He identified two observable activities that can be found in virtually all settings where (group) awareness plays a prominent role. The first of these activities is "displaying" which can loosely be described as the process of making something aware. The second activity is "monitoring", and it refers to the process of actually becoming aware of information that was displayed by others before. Coordination between collaborators can be regarded as an ongoing cycle between displaying and monitoring activities. The next two sections discuss some empirically open questions that can be associated with displaying and monitoring activities.

## 2. Displaying

Displaying refers to the processes by which the things to be made aware of are generated. There are several methods of how to design and support displaying activities, but we only have a very rough understanding of what method is appropriate in a given context. This section describes four different issues that are associated with different design options.

The first issue to be discussed refers to two alternative principles that can lead to the display of awareness information which are commonly referred to as explicit feedback vs. implicit feedback in the literature on information retrieval systems. Explicit feedback involves a deliberate, intentional and conscious displaying activity by learners. For instance, in Bodemer's study (2010), participants intentionally assigned graphical elements in the collaborative integration task to express their current understanding of statistics concepts. Another type of explicit feedback is through user/learner ratings, and this method was employed in the studies by Dehler et al. (self-assessments), as well as Phielix et al. (assessments of self and others). In contrast, in implicit feedback systems tools automatically generate awareness information without requiring dedicated learner activities. The studies by Sangin et al. (provision of information about knowledge tests) and Janssen et al. (provision of information about the amount of participation) are examples of this form of display. The question, then, is if one type of displaying is advantageous with regard to collaborative learning. Not surprisingly, many computer scientists and engineers prefer implicit feedback systems, mainly because awareness information is gained rather elegantly and unobtrusively. Moreover, as pointed out by Sangin et al. (2011), tools that do not require explicit ratings provide objective rather than subjective knowledge awareness. However, particularly in the field of collaborative learning one should consider potential benefits of explicit feedback and display. Ratings and explicit displaying activities might involve additional workload and potential distraction from the learning tasks, but they cater quite well to the constructivist nature of many learning tasks. For instance, requiring learners to rate aspects of their collaboration with regard to cognitive or social categories might serve as a meta-cognitive prompt that helps to reflect on a task. The Radar and Reflector tools by Phielix et al. (2010) are based on this potential. Furthermore, explicit activities like assigning graphical elements (Bodemer), rating oneself (Dehler et al.), or rating others (Phielix et al.) can be regarded as a low-level form of active participation. Participation, in turn, is one of the most important antecedents of success in collaborative learning. Finally, implicit feedback is probably at an advantage for some types of group awareness. For instance, it would be quite difficult to extract friendliness or reliability of co-learners without recourse to explicit ratings. There might be ways to get such information through computerized means (e.g. latent semantic analysis of contents), but these solutions are associated with relatively high computational costs and potentially low validity. Moreover, being told by an algorithm how a group "feels", might lead to reactance. Nonetheless, it would be very interesting to see studies that directly compare explicit and implicit feedback or display. For instance, one could use the tool from Dehler et al., and compare self-assessments of knowledge with fine-grained results of a knowledge pretest. Or one could ask learners to rate the participation levels of their collaborators, and compare this to the tool employed by Janssen et al. (2011).

A second issue with regard to displaying refers to the question of using dynamic vs. static displays of awareness information. For instance, the collaborative integration tool employed by Bodemer (2010) provides learners with awareness information that is constantly updated through ongoing activities in real time. The participation tool of Janssen et al. is similarly dynamic. In contrast, the remaining tools described in this issue rely on static awareness information that was gained before group interaction (Dehler et al., Sangin et al.), or in repeated display cycles during collaboration (Phielix et al.). The advantage of dynamic displaying is that it provides learners with up-to-the minute information about the collaborative process that can lead to immediate fine-tuning of activities. However, at least for explicit feedback methods there is a trade-off between immediacy and additional workload associated with repeated ratings.

Thirdly, there is the issue of encouraging or even forcing learners to display. This aspect was discussed by Janssen et al., and it was addressed through the design of the Phielix et al. tool where participants could only gain access to awareness information when they had completed their own ratings. Enforcing or scripting the display of group awareness might be burdensome and lead to lower tool acceptance. On the other hand, gaining a complete picture about cognitive and social variables in a group is one of the fea-