



Group awareness tools: It's what you do with it that matters

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ABSTRACT

This study examined the effect of using a group awareness tool on online collaboration. Furthermore, we examined whether the effect of using a group awareness tool on online collaboration is mediated by group awareness (i.e., students' awareness of their group members' levels of participation). To answer these questions, we determined how often and how long 107 secondary education students used the Participation-tool (PT), a group awareness tool designed to visualize group members' relative contribution to the online collaborative process. Our analyses show that duration of PT use (how long students displayed the tool on their screens) significantly predicted group members' participation in the online dialogue, their participation when writing collaborative texts, equality of participation within the group, and coordination and regulation of activities in the relational space (i.e., discussing the collaboration process with group members). No effect of using the PT on group performance was found. Mediation analyses showed that the effect of using the PT is only partially mediated by group awareness: an indirect effect of using the PT, via enhanced awareness of participation, on student participation during chat discussions and the collaborative writing process was found.

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1. Introduction

Although computer-supported collaborative learning (CSCL) has been identified as a promising educational approach, the research on the effectiveness of CSCL and the processes that take place during CSCL demonstrate that the collaboration in these environments is not always effective and efficient. These problems may include conflicts between group members (e.g., Hobman, Bordia, Irmer, & Chang, 2002), free riding behavior and unequal participation (e.g., Fjermestad, 2004). Some problems however, may be unique to CSCL environments or may be exacerbated in these environments, such as difficulties coordinating one's actions with other group members' actions (Baker, Greenberg, & Gutwin, 2001; Ellis, Gibbs, & Rein, 1992; Erkens, Jaspers, Prangmsma, & Kanselaar, 2005). These coordination problems, whether they occur in the *content space* (i.e., efforts aimed at problem-solving, such as exchange of information or discussion of answers and alternatives) or the *relational space* (i.e., efforts to establish a positive group climate and to ensure effective and efficient collaboration) of collaboration (Barron, 2003; Slof, Erkens, Kirschner, Jaspers, & Janssen, 2010), may be caused by a lack of group awareness (Buder & Bodemer, 2008; Dourish & Bellotti, 1992). Recently, researchers have begun to examine how group awareness tools can be used to enhance group

awareness and to study whether group awareness tools affect collaborative learning and group performance (Janssen, Erkens, & Kanselaar, 2007; Janssen, Erkens, Kanselaar, & Jaspers, 2007; Jer-mann & Dillenbourg, 2008). The aim of this paper is to examine how use of a group awareness tool affects the collaborative learning process and group performance.

1.1. Group awareness

Rafael: What do you think of the Debate now?

Casey: Fine.

Rafael: And what did you do Casey?

Rafael: Nothing was added to the Debate...?

Rafael: What are you doing now in the Debate, Case? Don't put anything in there cos you'll mess up the order.

Casey: Oops. Too late!

Casey: I've added source 3 to propaganda as a new argument. By accident!!

Rafael: I see. Grrrrr:-|

Rafael: Do you know what Lara is doing?

Casey: She's supposed to be working on the Martyrs position. . .

Rafael: I get the feeling she's letting us do most of the work.

Casey: So do I!

The chat-fragment above comes from two male secondary education students working in a CSCL environment. They are members

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of a three-person group, and they are currently working on the creation of a representation of a historical debate in an argumentative diagram called the Debate-tool. This fragment highlights two of the most common problems that group members encounter during online collaboration. Rafael is uncertain about what Casey is doing in the Debate-tool. He warns Casey about messing up the order in the tool, but he is too late. This is a sign of coordination problems with respect to the content space of collaboration. Additionally, they wonder about their other group member, Lara. They have no idea what she is doing, if she is even online, and whether she is doing what she is supposed to be doing. On top of that, they are afraid she is letting them do the lion's share of the work, but they do not know that for sure. This is an indication of coordination problems in the relational space. In sum, this fragment illustrates Rafael and Casey lack *awareness* information (Dourish & Bellotti, 1992).

The issue of awareness has received considerable attention in the area of computer-supported cooperative work (CSCW, Schmidt, 2002). This has led to a multitude of definitions of awareness and to the identification of a large number of different forms of awareness, such as passive awareness (Dourish & Bellotti, 1992), workspace awareness (Gutwin & Greenberg, 2002), social awareness (Bødker & Christiansen, 2006), conversational awareness (Mendoza-Chapa, Romero-Salcedo, & Oktaba, 2000), history awareness (Kreijns & Kirschner, 2001), knowledge awareness (Engelmann, Dehler, Bodemer, & Buder, 2009), and group awareness (Buder & Bodemer, 2008). Although there are differences between these forms of awareness and their definitions, their main commonality is their focus on information, or rather, the lack thereof in CSCL environments. In CSCL environments, it is often difficult to obtain information about what the other is doing, whether he/she is available for communication and interaction, what the others know about the task at hand, what group members will do next, and so on (Gutwin, Stark, & Greenberg, 1995). In this study we focus on *group awareness*, which can be defined as knowledge about the social and collaborative environment the person is working in (e.g., knowledge about the activities, presence or participation of group members; see Buder and Bodemer (2008)).

If group awareness is a problem of perception and information (Romero-Salcedo et al., 2004), why would this be problematic for group members working in a CSCL environment? Consider the chat-fragment above. Because Rafael and Casey lack information about their group members' activities, their collaboration is far from smooth. Note for instance Rafael's irritation after Casey's mistake. Group awareness information can reduce group members' efforts to coordinate their actions, can increase their efficiency, and reduce the chance of errors (Gutwin & Greenberg, 2004).

During collaboration, group members have to engage in different types of activities. These activities often have to do with the execution of the task, while others have to do with the coordination and regulation of the task. But group members also need to regulate and coordinate the social aspect of collaboration. For instance, they need to coordinate their collaboration: Who is available for discussion and communication? Who needs help? Is the collaboration going fine or should changes be made? This means that group members need awareness information about the relational space as well as information about the content space of collaboration. A common problem in collaboration is for example, the free rider effect: one student lets the other group members do most of the work (Salomon & Globerson, 1989). This is obviously not in the best interest of the group and therefore needs to be avoided. But it is often very difficult to determine whether free riding behavior is occurring. Rafael and Casey think that Lara might be taking a free ride, but without the proper information they cannot be certain. Thus, while working in a CSCL environment, group members not only require awareness information about the content space, but

also about the relational space. In sum, CSCL environments should incorporate tools or mechanisms that offer students group awareness information to facilitate coordination and regulation of activities in both spaces. Such tools are called group awareness tools (Buder & Bodemer, 2008).

1.2. Using group awareness tools to increase group awareness

Collaborating in CSCL environments is a complex endeavor. Group members have to carry out many different activities, while keeping track of the overwhelming amount of information that is available in the environment (e.g., the chat history detailing all the decisions that were made by the group or the version history of shared documents that are being written). The collection and interpretation of such information is a cognitively demanding task. From the perspective of cognitive load theory (Paas, Renkl, & Sweller, 2003; Sweller, Van Merriënboer, & Paas, 1998), collaboration in these environments generates high levels of intrinsic and extraneous cognitive load (Kirschner, Paas, & Kirschner, 2009; Van Bruggen, Kirschner, & Jochems, 2002), for example due to the necessity to keep track of group members' actions and the progress of the task as well as the need to communicate with group members to ensure optimal inter-individual coordination.

Group awareness tools can assist students in collecting the required information to collaborate effectively in CSCL environments. One approach to develop such tools is to visualize information that is important for the development of group awareness (cf., Janssen, Erkens, Kanselaar, et al., 2007; Jermann & Dillenbourg, 2008). Visualizations can make it easier to collect and interpret this information, because "it is possible to have a far more complex concept structure represented externally in a visual display than can be held in visual and verbal working memories" (Ware, 2005, p. 29). Visualizations can display large amounts of information and can facilitate its interpretation. They can therefore decrease the cognitive demands placed on individuals (Keller & Tergan, 2005; Sweller & Chandler, 1994). Visualizations for example, facilitate computational offloading (Ainsworth, 2006) since team members need to invest less effort to collect and interpret the information they need to collaborate successfully in a CSCL environment. On the other hand, adding visualizations to a CSCL environment to enhance group awareness can also increase cognitive load for students, because they have to pay attention to the visualization and have to interpret the information displayed by the visualization.

In this study, students used a group awareness tool called the Participation-tool (PT, see Fig. 1) while they were collaborating in

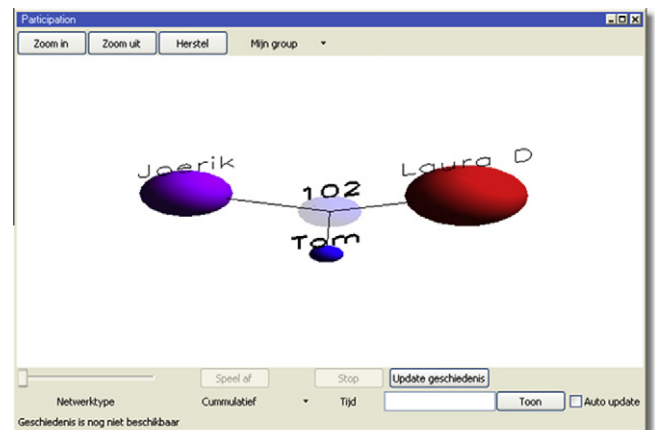


Fig. 1. Screenshot of the Participation-tool.

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