Online visualization of agreement and discussion during computer-supported collaborative learning

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Abstract: This paper describes the *Shared Space* (SS), a tool that visualizes discussion and agreement during online discussions by analyzing students' chat messages. The SS therefore provides group members with feedback about the way they are conducting their online discussions. It is hypothesized the SS will increase the media richness of the CSCL-environment, stimulates critical and exploratory group norms, leads to more positive perceptions of online collaboration, and will have an impact on students' collaborative activities.

Introduction

To connect to the developments in our society, teachers and students are increasingly using ICT to facilitate learning of various subjects. Computer-supported collaborative learning (CSCL) is one application of ICT that has received considerable attention by educational researchers. When students work together in a CSCL-environment, they usually use text-based CMC to communicate with their group members. Because CSCL often involves working on complex, even "wicked" problems, students need to engage in complex interactions. Thus, the problems group members may experience during online collaboration, may pose a serious threat to the effectiveness of CSCL. Furthermore, several researchers have noted that it is difficult for students to engage in argumentation: often their discussions are not critical (e.g., counterarguments are not given, c.f. Munneke, Andriessen, Kanselaar, & Kirschner, 2007) and/or not constructive (e.g., conflicts arise, c.f. Hobman, Bordia, Irmer, & Chang, 2002). Again, this may hamper online learning.

Communication difficulties and absence of critical but constructive discussion

The communication problems found during CSCL may be due to the medium itself. Traditional text-based CMC systems, such as chat, are seen as media that are low in *media richness* (Daft & Lengel, 1986). Media richness is defined as a medium's ability to facilitate communication and the establishment of shared meaning. Factors such as the ability of the medium to transmit multiple cues (e.g., facial expressions, intonation of voice), and the immediacy of feedback influence its media richness. As media richness decreases, students will have more difficulties conveying their opinions and will have more difficulties determining the meaning of group members' messages. Furthermore, when working on group tasks students usually work on complex problems without demonstrably correct answers, which require them to resolve differing viewpoints. The type of communication usually used during CSCL, may not be suited to the types of tasks group members work on (Mennecke, Valacich, & Wheeler, 2000). The low media richness of CSCL-environments may constrain collaboration in such a way that it does not transmit the type of communication that group members need to solve their task successfully. This may lead to communication problems and decreased task performance.

During online collaboration, group members should ideally engage in discussions that are critical, but also constructive. This means that group members are critical of their own and the other group members' ideas, that criticism is accepted, and explanations are given. These types of discussions have been called exploratory discussions and have been found to enhance learning during group work (Wegerif, Mercer, & Dawes, 1999). However, research has shown that students rarely give arguments and counter arguments during collaboration (Hightower & Sayeed, 1995).

This absence of critical but constructive discussion may be explained in several ways. First, students may not know how to conduct such discussions and may not posses the necessary skills. Second, as stated above, students may find it difficult to conduct constructive debates in a CSCL-environment and may have difficulties interpreting discussions, due to the lower media richness of the environment. For example, they may not know whether group members agree or disagree with them. This possibly hampers argumentation and discussion. Finally, groups may possess group norms that stimulate consensus among group members, instead of critical or exploratory

discussion. In conclusion, the relative absence of critical discussion during CSCL may have different causes. These causes need to be addressed in order to facilitate critical but constructive discussions during CSCL.

Adressing communication and discussion problems using visualizations

This section describes how visualizations of online dialogue may help address the previously described communication problems and the relative lack of critical but constructive discussion. Several researchers noted the lack of social cues of CSCL-environments. For users of chat rooms or discussion boards, it is often very difficult to quickly determine who the participants of online discussions are, or what the social norms of the online group are. This lack of awareness may constrain social interaction. To address this problem, researchers have turned to visualization techniques that visualize important social features of the environment (e.g., Donath, 2002). It is expected that by using such visualizations, social awareness can be increased, which may in turn lead to more productive interaction. Therefore, a visualization called *Shared Space* (SS) was developped. It visualizes whether group members are agreeing or disagreeing about a topic during online discussion. This visualization has been implemented in an existing CSCL-environment, called *Virtual Collaborative Research Institute* (Janssen, Erkens, & Kanselaar, 2007). The SS is an extension of the *Chat tool* of the VCRI-program. The SS analyzes all messages entered in the Chat tool. Figure 1 shows a screenshot of VCRI's Chat tool with SS visualization.

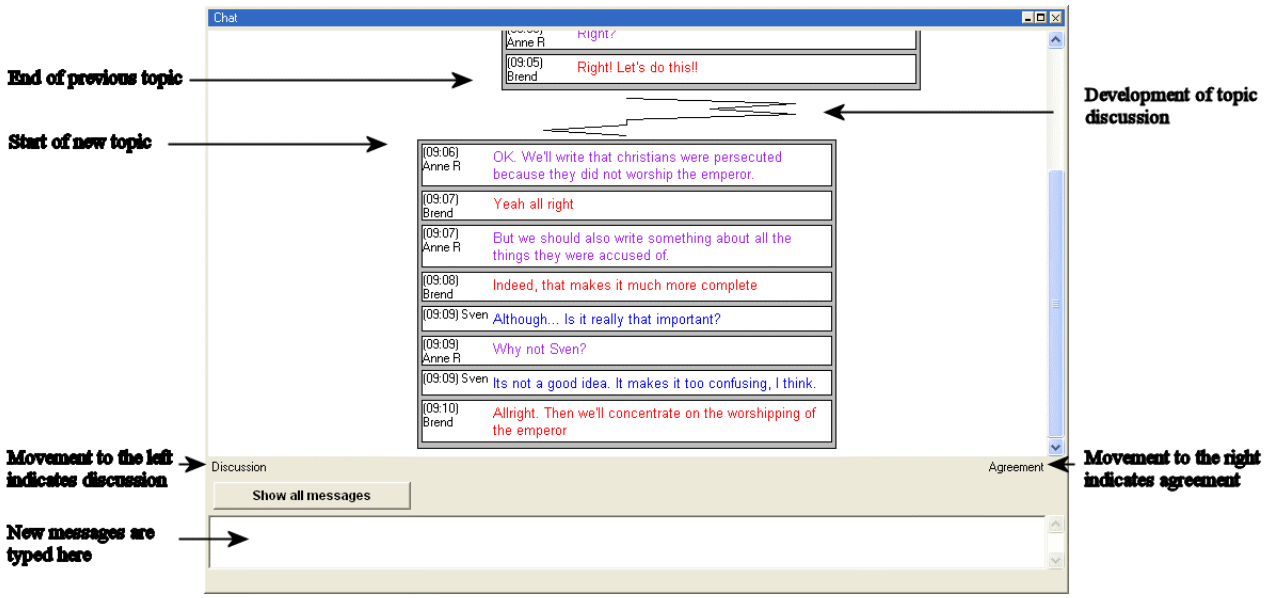

Figure 1. Screenshot of a chat window with Shared Space visualization.

First, the SS tries to determine whether a new topic or discussion has started. A new topic starts when no chat messages have been entered for more than 60 seconds. If that is the case, the current topic is ended. When a new message is entered, this marks the start of a new topic. Figure 1 shows how this is visualized in the SS. Second, the SS analyzes the content of each chat message in order to determine whether it indicates discussion or agreement. For this purpose, the SS determines the communicative function of the message. This is done using the *Dialogue Act Coding (DAC) filter* (Erkens & Janssen, 2006). This filter uses over 1300 rules based on discourse markers to determine the communicative function of a chat message. Discourse markers are characteristic words or phrases signaling the communicative function of a message (Schiffrin, 1987). In total, five main categories of communicative functions are distinguished. Each category consists of several subcategories, 29 in total. Of these, confirmations, acknowledgements, and positive evaluations are considered indications of agreement, while denials, verification questions, negative evaluations, and counterarguments are considered indications of discussion or debate. The reliability of the DAC filter was tested and found to be acceptable (Erkens & Janssen). Finally, after establishing whether the message indicates discussion or agreement, the SS moves the current topic to the left or to the right in small steps (see Figure 1). When a message indicates discussion, the SS moves the topic to the left; when it indicates agreement, the SS moves the topic to the right. This is alo reflected by the lines above the topic, which visualize the development of the current topic. These lines show that at the beginning of the depicted discussion, group members seemed to be in agreement (c.f., the first two messages by Anne R. and Brend), later on students

started challenging and questioning each others' ideas and the topic moved to the left (c.f., the three messages at 9:09 by Sven and Anne R.).

It is hypothesized that the SS visualization will help group members overcome the communication and discussion problems described above for several reasons. First, the SS may increase the media richness of the CSCL-environment. Because the SS visualizes discussion and agreement, it may be easier for students to determine the meaning of messages. Additionally, it may be easier to identify the different views and positions held by group members. Moreover, the SS may help group members to determine whether there is shared understanding about a topic. Second, the SS provides group members with feedback about the manner in which they are conducting their discussions. For example, when the SS keeps moving to the right, this tells group members they may be engaged in an uncritical discussion. Thus, the feedback provided by the SS visualization may increase students' awareness about their conversational strategies and their group norms. Finally, by providing them with feedback and raising their awareness, the SS may help students perform group processing activities. This occurs when group members discuss how well their group is functioning and how group processes may be improved. During these discussions group members may be stimulated to adopt more critical or exploratory group norms. In conclusion, it is expected that SS visualization may address some of the communication problems that occur during CSCL, and may help group members to collaborate and discuss more productively.

Conclusion

This paper described the Shared Space (SS), a tool that visualizes whether group members seem to agree or disagree during their online chat sessions. The SS provides students with feedback about whether they are conducting valuable discussions (e.g., not overly critical and not too uncritical). It is hoped that by giving students such feedback, they will adapt their online behavior if necessary. The SS has been tested in a research experiment (Janssen et al., 2007), and the results indicate that the SS seems to make it easier for students to know whether their group members are agreeing or disagree with them. Furthermore, it seems to stimulate students to adopt critical group norms, instead of consensus group norms. Finally, the SS has been found to influence students' online collaboration, by reducing the amount of effort group members had to devote to reaching and maintaining mutual understanding.

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