Knowledge convergence in CMC: The impact of convergence-related external representations

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Abstract: Knowledge convergence is at the heart of even very different approaches to collaborative learning. Recent empirical work revealed that knowledge convergence falls behind the expectations because only modest amount of shared knowledge could be found. We investigate knowledge awareness as a method to foster the emergence of knowledge convergence in an experimental study. Knowledge awareness provides collaborators with convergence-related external representations. This was found to support learners in tapping their convergence potential.

The emergence of knowledge convergence in collaborative learning

Knowledge convergence (KC), that is knowledge collaborative learners share, is a concept widely distributed even among rather different approaches to collaborative learning, like intersubjective meaning-making and individual learning by knowledge exchange (Suthers, 2006). Thus, research on KC should face a broad interest.

We follow an outcome approach to KC, thus focusing on the amount of shared knowledge rather than the processes of how mutual knowledge is achieved. Jeong and Chi (2007) differentiated shared access to environmental conditions and joint interaction as two sources of KC. As group members in studies of collaborative learning are usually exposed to the same input (e.g. task, instruction, learning materials) separating the two sources empirically is difficult. Our empirical approach will *assess both KC due to interaction and KC due to shared input*. Comparing KG in video-conferencing and face-to-face collaboration, Fischer and Mandl (2005) found that KC does not depend on the varied media characteristics. However, even with video-conferencing collaborators still interact synchronously and experience mutual visibility and audibility. Empirical evidence of *KC in written computer-mediated communication* is missing. The modest amounts of KC typically found (e.g. less than 20% in the Fischer and Mandl (2005) study) point out the need for identifying and evaluating conditions beneficial for KC. Content-related external representations were shown to not support KC (Fischer & Mandl, 2005). We suggest using *convergence-related features of external representations* rather than content-related features in order to support KC.

We carry on the notion of *knowledge awareness* (Dehler, Bodemer & Buder, 2007; Sangin, Nova, Molinari & Dillenbourg, 2007). Collaborators are provided with knowledge awareness as they are informed about their partner's knowledge by means of external representations. This discloses convergence-related information to learners because they can see whether or not they share knowledge. This allows learners to easily infer what interaction activities are appropriate. For example, if group members are aware of not sharing a specific knowledge item they are thought to engage in information-seeking or information-providing activities which increase KC.

Empirical study

Design. 38 pairs of student participants were randomly assigned to two experimental conditions. The availability of knowledge awareness was introduced as independent variable. Subjective estimations of knowledge were assessed and visualized as boxes next to each text paragraph (Dehler, Bodemer & Buder, 2007). In the control condition only Ss´ own knowledge was presented. Ss in the knowledge awareness condition were additionally provided with equally self-reported knowledge of their partner. Three combinations of knowledge were possible: shared knowledge, shared deficit, unshared/complementary knowledge.

Procedure. First, participants learned individually for 15 minutes with a hypertext on the immune system. The learning material was divided into 15 paragraphs. For each paragraph learners had to indicate whether or not they know the respective content by tagging small boxes as white (deficit) or green (knowledge). Then, dyads communicated for 30 minutes with the goal of text comprehension with questions and explanations as types of contributions in a communication thread. Knowledge awareness was varied in the collaboration phase. Afterwards, participants could change their tags. Thus, the number of shared knowledge items both prior to and after collaboration is used to compute KC, thus being operationalized as shared subjective knowledge.

Results and Discussion

Knowledge awareness condition dyads shared 44% of their knowledge *after collaboration* while control condition dyads shared 27% with the difference being significant, $F(1, 36) = 7.22$, $p < .05$. *Before*

collaboration, 35% of knowledge was shared in the knowledge awareness condition and 22% in the control condition, $F(1, 36) = 5.84$, $p < .05$. This level of convergence emerged without interaction but due to mere shared input.

Increase in KC is not appropriate as a measure here as conditions significantly differed in their level of convergence before collaboration. The potential for increase in shared knowledge is limited to knowledge items that have not been shared prior to collaboration. Thus, we divided the increase in shared knowledge items by the potential for increase, thereby calculating the *percentage of realised potential* which entered ANOVA. Dyads with knowledge awareness realised more of their potential than control condition dyads (see left bars in Figure 1), $F(1, 36) = 4.17$, $p < .05$. However, this result could still be biased by chance because the smaller the potential (like in the knowledge awareness condition) the more probable is it to converge. Therefore, KC for nominal dyads (i.e. dyads artificially rearranged within conditions to non-interacting pairs) was assessed. If chance alone could explain the difference between conditions in realized potential this difference should also occur with nominal dyads. However, for nominal dyads realization of convergence potential with knowledge awareness did not differ from the control condition (see right bars in Figure 1), $F(1, 36) = 0.16$, $p = .69$. Hence, knowledge awareness was found to support learners to put into effect their KC potential.

A two-factorial (condition: knowledge awareness vs. control; dyad type: real vs. nominal) ANOVA showed that the realization of KC potential was not higher in real than nominal groups, $F(1, 75) = 0.25$, $p = .62$. Figure 1 illustrates that real dyads tended to converge more than nominal dyads in the knowledge awareness condition while in the control condition real dyads realized even slightly less of KC potential compared to nominal dyads, with the interaction being not significant, $F(1, 75) = 1.33$, $p = .25$. This indicates that written computer-mediated communication impairs the development of KC, but only if it is not enriched by convergence-related representations like the knowledge awareness tools used in this study.

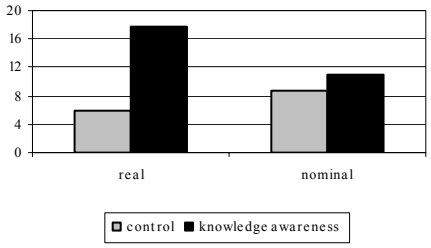

Figure 1. Percentages of realized KC potential for both conditions, for real and nominal (non-interacting) groups.

Future directions

Analysis of communication threads will shed light on whether or not KC was fostered by increased amounts of interaction (e.g. by number of turn-taking, Jeong & Chi, 2007). More specifically, the assumption that role differentiation and task coordination are crucial processes for the emergence of KC will be validated (Fischer & Mandl, 2005). Instructional support of convergence was suggested by explicitly structuring the interaction by means of collaboration scripts (Fischer & Mandl, 2005). Explicit and implicit (like presented in this study) approaches should be compared empirically to find out if they equally foster KC and if similar or different processes account for their support. If different processes are effective, both approaches can even be combined to help learners converge.

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