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Development of an instrument to assess the quality of collaboratively constructed notes

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Abstract: We developed a rating scheme to assess the quality of information pooling and reaching consensus in collaboration through the rating of a shared text document.

Introduction

During CSCL, we often explicitly encourage learners to share and elaborate on relevant information and instruct groups to discuss not only shared, but also initially unshared information. But even if participants share all important information verbally, they may fail to properly document it in writing and may not use it during their collaboration and decision-making process. In situations, where large amounts of information from different perspectives have to be considered, this may cause a loss of information and unfavorable outcomes. Therefore, students are often encouraged to take notes during synchronous collaboration.

Notes that students construct synchronously in collaborative settings can be categorized as text-based artifacts (Trausan-Matu & Slotta, 2021). These artifacts serve the intersubjective knowledge building by making the shared information visible and persistent (Stahl, Ludvigsen, Law & Cress, 2014). In being documented, this information becomes the groups' intersubjective knowledge and basis for decision-making and helps avoid long-term loss of information. In addition to overcoming the information pooling dilemma (Stasser & Titus, 1985), collaborative notes help the group to maintain awareness of consensus that was already reached. Consequently, collaborative notes serve to support the central CSCL processes information pooling and reaching consensus that are included in the dimensions that determine the quality of computer-supported problem solving and learning processes proposed by Meier et al. (2007).

Collaborative notes, thus, should be included in the analysis of CSCL settings, complementing the analysis of video and log data. However, these notes have not received much attention in the analysis of data from CSCL settings so far. With this contribution, we would like to put forward a rating scheme that allows us to quantify and analyze the groups' persistently shared information in collaborative notes and relate it to various data sources.

Development of the Rating Scheme

The rating scheme was developed in the context of a study that aimed at fostering collaboration skills in higher education students. Participants collaborated in groups of three via a video-conference tool. During the study participants had to find a joint solution for two complex, open-ended problems in a learning phase and in a testing phase respectively. Each learner received an individual role description with complementary information. To solve the problem, pooling of the individual information was necessary. We encouraged the groups to use a shared digital notepad to document their information sharing and decision finding processes.

To quantify the qualitative aspects of the collaborative notes in the shared digital notepad, we opted for a regular code and count approach. The unit of analysis is on the group-level, as specific notes cannot be traced back to individual learners. We developed the rating scheme in an iterative process. For the initial development, we used a sample of N=10 collaborative notes which we collected in a pilot study with 30 higher education students. In this first step, we developed an initial set of codes by adapting the aspect *joint information processing* including the dimensions *information pooling* and *reaching consensus* by Meier et al. (2007) and applied them to the collaborative notes. We focused on these two dimensions because we expected them to manifest in the collaborative notes since they document the discussion and problem-solving process.

For the *information pooling* dimension, we broke down the assignment and role material into units of information that we expected to appear in the collaborative notes because of their vital function for the joint solution. From the units of information, we generated the codes on the *information pooling* dimension. Each participant had a maximum of seven units of information to share with the group, containing requirements, arguments and a solution proposal.

The dimension of *reaching consensus* gives attention to the process of decision making. It aims at discussing and critically evaluating information in order to make a joint decision. We created sub-codes based on the way consensus was presented and elaborated in the pilot sample. Some groups highlighted pro and contra

arguments for different solution proposals with '+/-' symbols for example. Groups differed in how elaborate their final solution was: they ranged from simply stating 'solution: first idea' to explaining the final idea in detail and justifying it with arguments. Therefore, the codes for evaluation of information and joint solution were rated depending on how elaborate and consistently the information was processed and included in the final solution.

We added *grounding* as a third dimension, after reviewing the remaining uncoded information in the collaborative notes of the pilot sample. *Grounding* includes the introduction of participants and the designation of a common goal.

In a second step, we refined the initial rating scheme by writing out the codes concisely. We then applied it in a laboratory study. The refined coding-scheme was used with a sample of N = 11 collaborative notes of 33 participating higher education students so far. The sample was coded and rated by two independent raters.

Result

The final rating scheme consists of three dimensions with several sub-codes: 1) *Information pooling* consists of the three sub-codes *unique requirements* and *arguments*, *unique solution proposals*, and *unshared information* of each role. If shared in the notes, the units of information in this dimension scored 0.25, 0.5 or 1 point depending on their importance for the solution-finding process. 2) *Reaching consensus* consists of the five sub-codes *sorting information* (by role or solution proposal), *indication of pros and cons* for each solution proposal, *recording of a consensual final solution*, *recording of requirements met/not met by the final solution* and *justification of the final solution*. Each sub-code is rated as *non-existing* (=0), *partially found* (=1) and *consistently found* (=2). 3) *Grounding* consists of the three sub-codes *indicating roles* (=1), *role names* (=1) and *indication of the common goal* (=1). Altogether, groups can reach a total of 25 points (*information pooling*=10, *reaching consensus*=12, *grounding*=3) in the learning and the testing phase, respectively. The score indicates the quality of the group's joint information processing and can then be used in statistical analysis.

The two independent raters reached an Inter-Rater-Agreement of *Cohen's Kappa*=.66, which can be interpreted as substantial agreement. We resolved remaining disagreements by mutual discussion and were able to reach consensus in all cases. We successfully applied the rating scheme on a dataset of *N*=33.

Discussion and Outlook

We developed a rating scheme for synchronously and collaboratively constructed notes that document information pooling and decision-making processes in CSCL settings. The rating scheme offers an additional way to assess how well groups document their information pooling and decision-making process in writing and allows for comparison between groups and different experimental conditions. The rating can be included in statistical analyses. It has the potential to complement video data and can, therefore, help shed light on the role of intersubjective knowledge building during information pooling and decision-making processes. We can assume that groups which score higher on the information pooling dimension in their collaboratively constructed notes also share more information verbally and discuss information more extensively. However, consistently noting down information might also slow down or hinder the solution finding process. Therefore, the next step is to further validate the newly developed rating scheme by comparing it to video data of the collaboration processes.

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