FOSTERING COOPERATIVE CASE-BASED LEARNING IN VIDEOCONFERENCING: EFFECTS OF CONTENT SCHEMES AND COOPERATION SCRIPTS

Abstract. The study examines the support of cooperative case-based learning in videoconferencing. In particular, it assesses firstly how content schemes support the application of theoretical concepts on a case and secondly how cooperation scripts foster the interaction within groups of three (triads). 53 triads were randomly assigned to one of four conditions in a 2x2-factorial design. The factors content scheme (with/without) and cooperation script (with/without) were varied. The learners were asked to familiarize themselves with a theory individually before solving a case cooperatively in triads. To measure the effectiveness of the intervention, cooperative and individual learning outcomes were analyzed. Results show a main effect of content scheme on cooperative and individual learning outcomes. This effect is increased when a cooperation script is added.

OBJECTIVES

Videoconferences will be an important tool for future cooperative learning scenarios. Not only do they provide a video- and an audio-channel for visualization and communication, but they also support the cooperative case solution by means of application sharing. Using an application sharing learning partners in videoconference-settings are able to access and modify the same content on their individual screen (Dillenbourg & Traum, 1999). Beyond this, sharing an application learners have the possibility to work on a text document simultaneously and to solve a task cooperatively while they are in different locations. Furthermore, they can make their knowledge available on the screen for later reference (De Jong et al., 1998; Suthers & Hundhausen, 2001). This dissemination of unshared knowledge is very important for cooperation. Due to the continuous representation of disseminated knowledge the construction of cooperative knowledge changes (Dillenbourg & Traum, 1999). The cooperative dissemination of knowledge can be fostered with structuring methods.

THEORETICAL FRAMEWORK

The underlying framework of this study is cooperative learning under a socio-cognitive perspective (Renkl, 1997; Webb, 1989). The main assumption is that learners get activated through a self-directed cooperative work to construct and acquire new knowledge. Because learners do not automatically have the relevant cognitive and social competences for solving a task successfully, they need to be supported. The most promising results have been demonstrated through structuring the process of collaborative knowledge construction. Especially providing instructional assistance in relation to content specific strategies (Ertl, Reiserer, &
Fostering cooperative co-construction of knowledge

Content scheme
Content schemes support learners’ knowledge acquisition process in a content-related manner by a visualized representation of the task. This external representation of the main content aspects has two effects: On the one hand, it supports individual information processing (Larkin & Simon, 1987) and knowledge acquisition (Brooks & Dansereau, 1983) and on the other hand the cooperative case solution (Roschelle und Teasley, 1995). In a study on the acquisition of scientific theories, Suthers (2001) found that those groups, who worked with structural support, were significantly more successful than groups, who worked without this support. In videoconferencing, the study of Fischer, Bruhn, Gräsel and Mandl (2000) showed also advantages of a content-specific structuring method for the cooperatively compiled case solution.

Cooperation script
Cooperation scripts foster social, cognitive and meta-cognitive processes within the cooperation. By applying this structuring method, groups have been demonstrated to develop meta-cognitive activities by working together on an academic task (O’Donnell, 1999). Usually, cooperation scripts offer a procedural structure, where every step of the cooperation is prescribed. Implicitly, with this process structure, the cognitive role of the individuals is determined through specific tasks, too. Thereby processes are avoided that may influence the learning process and learning outcome negatively. Previous studies have shown that scripts foster certain activities, especially meta-cognition (O’Donnell, 1999). While this method was developed in face-to-face learning settings, it is increasingly implemented in computer-supported learning environments. For example, Weinberger, Ertl, Fischer and Mandl (2003) showed the effectiveness of this instructional method in text-based learning scenarios and in videoconferencing.

Measuring the learning outcome
To measure the effectiveness of the intervention (content schemes and cooperation scripts), the learning outcome is essential. The process taking place in cooperative case-based learning is reflected in the cooperative case solution (cf. Hertz-Lazarowitz, Kirkus, & Miller, 1992), which is documented in the collaborative application sharing. Furthermore, it is also important to measure the individual learning success to distinguish between cooperative and individual knowledge acquisition (Salomon, 1992; Salomon & Perkins, 1998).
RESEARCH QUESTIONS

This study investigates cooperative case solving in videoconferencing. The cooperative and individual learning outcomes are the main dependent variables to show the effectiveness of content scheme and cooperation script on cooperative and individual learning outcome. The following two research questions are examined:

(1) To what degree do content scheme and cooperation script and their interaction support the cooperative learning outcome?

(2) To what degree do content scheme and cooperation script and their interaction foster the individual learning outcome?

METHODS

Learning scenario

The study focused on the cooperative solution of a learning case with help of the Attribution Theory. Attribution Theory serves to explain behavioral phenomena. In pedagogy, this theory is used to explain especially the decreasing performance of students at school. Based on this theory, the case to be solved referred to the decreasing of performance of a student in the 8th grade in mathematics. The learners were asked to read a text on the Attribution Theory of Kelley (1973) and Heider (1958) and to learn the key concepts inherent in these theories. The cooperative task solution consisted of a correct attribution according to these concepts. In order to solve this task three main aspects were essential for learners: the theoretical classifications, the case information and the relation between theoretical classifications and case information. During the cooperation, the learners were connected via a desktop videoconferencing system that included (1) an audio- and video-connection and (2) a shared application to support the triads’ knowledge construction.

Participants and Design

159 undergraduates of Pedagogy and Psychology took part in this experiment. 53 triads were assigned to one of four conditions in a 2x2-factorial design. There were 13 triads in each condition and 14 triads in the group with content scheme. We varied the factors content scheme (with vs. without) and cooperation script (with vs. without).

<table>
<thead>
<tr>
<th>Content scheme</th>
<th>without</th>
<th>with</th>
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<tbody>
<tr>
<td>Cooperation script</td>
<td>without</td>
<td>13 triads</td>
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<tr>
<td></td>
<td>with</td>
<td>13 triads</td>
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</tbody>
</table>

Figure 1. 2x2-factorial design
Procedure

The experiment consisted of two main learning units: an individual unit, where the learners had to familiarize themselves with the Attribution Theory (30 minutes) and a cooperative unit, where the learners had to solve the case together (60 minutes). In the cooperative unit, the learners received a piece of general and a piece of specific case information. While the general information included the plot, the specific information focused on three different perspectives in the case – one divergent perspective for each learner. To solve the case together, it was necessary to extract all important information from the different perspectives.

Treatment

Both treatments, the content scheme and the cooperation script provided a pre-structure for the cooperation of the triads. While the cooperation script structured the activity into four phases, the content scheme fostered the collaboration domain-specifically with a visualization of relevant aspects of the content in an abstract way.

Content scheme

In the condition using content scheme, participants in the cooperative problem solving unit received a content scheme that provided a pre-structure for the relevant content in a specific way. In this content scheme, the cause is the starting point to reflect the main reasons for the problem turning up in the case. All possible causes mentioned in the three divergent perspectives have to been searched for. The next category consists of the theoretical concepts consensus and consistency, which are needed to confirm the causes. Furthermore, it is necessary to prove this estimation by annotating the relevant case information. The last category includes the attribution according to Kelley and Heider.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Information regarding</th>
<th>Attribution according to</th>
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<tbody>
<tr>
<td></td>
<td>Consensus</td>
<td>Consistency</td>
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<td></td>
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<td>Kelley</td>
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<td>Heider</td>
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Cooperation script

The cooperation script structured the cooperative problem solving unit in four phases, where individual and cooperative phases alternated. Each phase consisted of specific, instructed activities, the learners had to follow.

The first phase consisted of text reading and excretion of the relevant case information. In the first 15 minutes, every learner had to think of the main causes mentioned in the perspective and to note them down on paper individually.
In the second phase, learners were asked to exchange cooperatively their different information concerning the case and to ask the others as soon as something was not understood. Because the information of the perspectives differed in certain ways, it was necessary to discuss the varying causes and possible solutions. All issues which were relevant for the solution of the case had to be filled in the text document. For these collaborative activities, the learner had 25 minutes.

After expressing and noting down all main issues, the learners had to reflect five minutes on the appropriateness of the jointly developed notes in the third phase individually.

In the final, the fourth phase, the learners had 15 minutes time to discuss special issues, they reflected on during the third phase, and to decide on a final solution which was to be presented as the group solution.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Task</th>
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<tbody>
<tr>
<td>1</td>
<td>Reading and extraction of case information (individually)</td>
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<tr>
<td>2</td>
<td>Exchange of information, clarifying, discussing, writing the results in the document (cooperatively)</td>
</tr>
<tr>
<td>3</td>
<td>Reflection about the case solution (individually)</td>
</tr>
<tr>
<td>4</td>
<td>Discussion and final case solution (cooperatively)</td>
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</table>

**Dependent variables**

To measure the effect of the two treatments, learning outcomes were recorded: the cooperative solution of the case and the individual solution of the case, completed after the cooperation.

**Recording the cooperative learning outcome**

According to the different categories of the Attribution Theory, a coding system was developed, where all causes, information and attributions were listed in an identifiable way to operationalize the cooperative case solution. Three main categories were important: The theoretical classifications, the case information and the relations between theoretical classifications and case information.

**Recording the individual learning outcome**

To record how successful learners applied the theoretical knowledge to cases, a case was constructed, which was equivalent to the cooperative case. The analysis of the individual case was similar to the cooperatively solved case. Scores were given for theoretical classifications, case information and relations between theoretical classifications and case information.
RESULTS

In all conditions learners did not differ in their amount of pre-knowledge, which they had acquired during the individual learning phase. During the cooperation phase, learners of all conditions improved.

Cooperative Learning Success

Theoretical classifications

Regarding the theoretical classifications, groups with content scheme named twice as many classifications as groups without content scheme. This main effect of the factor content scheme was demonstrated by an analysis of variance (ANOVA) which showed a significant and strong main effect of the factor content scheme ($F(1,46) = 39.77, p < .01; \eta^2 = .46$).

Case information

Descriptively, groups with content scheme and cooperation script performed best, even though the ANOVA showed no significant effect ($F(3,46) = 2.12, n. s.$).

Relation between theoretical classifications and case information

Concerning the relation between theoretical classifications and case information, groups with content scheme related almost twice as often theoretical classifications to case information than groups without content scheme. An ANOVA showed a significant and strong effect for the factor content scheme ($F(1,46) = 53.31, p < .01; \eta^2 = .54$). The combination group performed best.

Individual Learning Success

Theoretical classifications

Groups with content scheme named in their individual case solution the highest number of theoretical classifications. That was confirmed by a significant and moderate effect of the factor content scheme ($F(1,154) = 13.36, p < .01; \eta^2 = .08$). Furthermore, an interaction effect was observed between cooperation script and content scheme, which however failed to reach the conventional significance level ($F(1,154) = 13.69, p < .1$). This is descriptively reflected in the highest scores of the combination group with content scheme and cooperation script.

Case information

Groups with cooperation scripts disseminated significantly more case information than groups without cooperation scripts. This lead to a significant, small effect of the factor cooperation script ($F(1,154) = 5.03, p < .05; \eta^2 = .03$).
Relation between theoretical classifications and case information
Concerning the relation between theoretical classifications and case information there was a main effect: Groups with content scheme related significantly more theoretical classifications to case information than groups without content scheme ($F(1,154) = 40.32, p < .01; \eta^2 = .21$). There was also a weak tendency for the factor cooperation script ($F(1,154) = 3.74, p < .1$).

CONCLUSION AND DISCUSSION
Results show strong effects for both factors, content scheme and cooperation script. The content scheme influenced the cooperative and the individual learning outcome: Learners with content scheme named significantly more theoretical classifications and relations between theoretical classifications and case information cooperatively and individually. This phenomenon is based on the salience of these two categories evoked by the structure of the content scheme.

Furthermore, the cooperation script showed a main effect for the dissemination of case information and a tendency for the relation between theoretical classifications and case information on the individual learning outcome, but not concerning the cooperative level. This result can be explained with the task structure of the cooperation script. In the first individual phase, learners had a lot of time for dealing with the case information. Eventually, the cognitive processes of this phase, which were mainly the extraction of case information, were carried forward on the individual case solution, but not on the cooperative case solution.

Another interesting result is the interaction between cooperation script and content scheme: the results of the learning success show that the group with content-scheme and cooperation script were best in almost all outcome measurements. There was also a tendency concerning an interaction effect between content-scheme and cooperation script concerning the theoretical classifications. As soon as the content scheme is combined with the cooperation script, the individual reflection phase of the cooperation script has a positive influence on the learning success. Only when the learners know the relevant aspects of the case solution, they can estimate the correctness and accuracy of the case solution.

To verify especially the interaction of the factors content scheme and cooperation script, further process analysis are necessary. In this context, discourse analysis concerning the socio-cognitive and epistemic level of knowledge construction are suggested.
REFERENCES


