Epistemic cooperation scripts in online learning environments: Fostering learning by reducing uncertainty in discourse?

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Abstract

Using online learning environments in higher education offers innovative possibilities to support collaborative learning. However, online learning creates new kinds of problems for participants who have not previously worked with each other. One of these problems is uncertainty which occurs when participants do not know each other. According to the uncertainty reduction theory, low uncertainty level increases the amount of discourse and decreases the amount of information seeking. Therefore, uncertainty may influence online discourse and learning. This study investigates the effects of an epistemic cooperation script with respect to the amount of discourse, information seeking and learning outcomes in collaborative learning as compared to unscripted collaborative learning. The aim was also to explore how and what kind of information learners seek and receive and how learning partners react to such information exchange. The participants were 48 students who were randomly assigned to groups of three in two conditions, one with and one without an epistemic script. The results indicate that the epistemic script increased the amount of discourse and decreased the amount of information seeking activities. Without an epistemic script, however, learners achieved better learning outcomes. The results of two qualitative case-based analyses on information seeking will also be discussed.

Keywords: collaborative learning, online learning environment, uncertainty reduction theory, cooperation script, amount of discourse, information seeking

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uncertainty in discourse?

Online learning environments can enhance collaborative learning in higher education,

for example, by providing shared workspaces in which learners can work together on

authentic problem cases (e.g., Strijbos, Kirschner, & Martens, 2004). However, online

learning environments do not guarantee that learners will interact with each other (Kreijns,

Kirschner, & Jochems, 2003). People participating in online learning courses do not often

know each other and are often unsure how to act in these learning environments. In initial

interaction situations there is some degree of uncertainty (Berger & Bradac, 1985; Berger &

Calabrese, 1975), and online, often physically distanced learning environments lack

immediate feedback and non-verbal cues, which might further increase uncertainty (e.g.,

Järvelä & Häkkinen, 2002; Roschelle & Pea, 1999).

Uncertainty can appear at least at two different levels: at the socio-emotional level and

at the epistemic level (Mäkitalo, Pöysä, & Häkkinen, 2003). At the socio-emotional level

uncertainty can occur, for example, when participants do not get immediate feedback on how

others are reacting to their messages, whether they agree or disagree with one's suggestions

and how they will organize their joint work. At the epistemic level, participants may be

uncertain about the content-wise quality of their contributions: Are their contributions

relevant regarding the issue? Do the learning partners understand the content of the message?

Due to the novelty and the complexity of its social context, online collaborative learning

courses can be regarded as a highly uncertain form of communication, in which learners may

need additional support to reduce uncertainty.

In this paper, one of our goals is to investigate discourses of online learning

environments with the help of the uncertainty reduction theory (Berger & Bradac, 1985). This

theory suggests that a high degree of uncertainty may hinder participants from communicating effectively with each other with respect to attaining shared goals (e.g., solving a problem together). In the communication science, Berger and his colleagues (Berger & Bradac, 1985; Berger & Calabrese, 1975) have developed the uncertainty reduction theory, seeking to explain how uncertainty affects communication. Originally, this theory was not related to online learning. The important components of this theory, which we are applying to online learning, are *uncertainty*, *the amount of discourse,* and *information seeking*. Berger and his colleagues show that as the amount of verbal communication in initial interaction situations increases, the level of uncertainty decreases. Furthermore, as uncertainty is reduced, the amount of verbal communication increases. They also point out that information-seeking behavior is increased in uncertain situations. As uncertainty is reduced, information-seeking behavior decreases (Berger & Bradac, 1985; Berger & Calabrese, 1975). Therefore, uncertainty may influence online discourse. However, the relation of uncertainty and uncertainty reduction activities, e.g. information seeking, to learning outcomes has not yet been investigated systematically.

In collaborative learning environments, specific forms of discourse are considered important for learning. The kind of discourse in which participants ask certain types of questions, evaluate suggestions, elaborate explanations and justifications, hypothesize and summarize the ongoing discourse, seems to be especially effective for learning in collaborative situations (King, 1999; Webb, 1989). Information seeking itself does not necessarily foster collaborative learning, but it can be seen as a mediator to learning processes, from comprehension to knowledge construction (King, 1999). According to King (1999), open-ended and thought-provoking questions enhance the discourse, because they provoke explanations and reasons. Elaborating explanations to learning partners is a good

predictor of responder's achievement (Webb, 1989). King (1999) points out that comprehension questions are not very thought provoking, because they are memory-based and ask learners only for recall of the presented material. Responding to comprehension questions requires a learning partner to reformulate definitions and descriptions by paraphrasing them in their own words, which enhances the responder's own thinking and learning. On the other hand, learning takes place when the information seeker receives the relevant help and understands it and has an opportunity to elaborate the received information (Webb, 1989). The discourse pattern which includes information seeking, responding to information seeking and receiving requested information, is seen as an important process for collaborative learning (King, 1999; Webb, 1989).

The activities of collaborative learning, such as knowledge articulation, explanations, argumentation and other demanding epistemic activities can be supported in different ways by communication tools and shared workspaces in online learning environments (e.g., Häkkinen, Arvaja, & Mäkitalo, 2004; Strijbos et al., 2004). One of the recent approaches to facilitate online collaborative learning at the process level is to provide learners with cooperation scripts that specify and sequence their collaborative learning activities (Dillenbourg, 2002; Kollar, Fischer, & Hesse, 2003; Weinberger, 2003). Cooperation scripts, i.e. a set of rules that prescribe the way learners should interact with each other and collaboratively work on a task, have been found to facilitate collaborative learning activities in face-to-face learning environments (O'Donnell, 1999). Prior to collaborative learning, learners are verbally instructed to engage in specified activities at certain times. In the context of online collaborative learning, the script is represented by the interface design instead of verbal instructions and training. The interface specifies and sequences activities during the actual collaborative learning phase, for instance, by prompting learners to answer specific questions

(Weinberger, 2003). Beers, Boshuizen, Kirschner and Gijselaers (this issue) present an example of a tool, which scripts online negotiation of meaning.

Typically, scripts give a complex set of instructions to collaborative learners with respect to several goal dimensions. The prototypical script of O'Donnell and Dansereau (1992), for instance, supports meta-cognitive and elaborative activities of collaborative learners. This script for text comprehension asks learners to read through paragraphs, repeat them in their own words, mutually monitor these summarizations for mistakes, and elaborate the given text. Scripts may also aim at specific process dimensions of collaborative learning, for example, to particularly support epistemic activities. An epistemic cooperation script aims to facilitate cognitive processes by providing collaborative learners with a strategy to solve a task. On one hand, epistemic scripts may enhance collaborative activities such as explaining (Coleman, 1998), questioning (e.g., Ge & Land, 2002; Hron, Hesse, Cress, & Giovis, 2000), and expert-like problem-solving behavior (Dufresne, Gerace, Thibodeau Hardiman, & Mestre, 1992). On the other hand, epistemic scripts may disturb epistemic activities if the scripts are too detailed (Baker & Lund, 1997; Dillenbourg, 2002) or they are underestimating expert learners' capabilities (Cohen, 1994; Salomon & Globerson, 1989) or overrating novice learners' resources (Dansereau, 1988). One of the major questions in this field is to what extent interaction should be structured on an epistemic level in order to support the way learners cope with the uncertain situation of online learning.

Aim of this Study

The aim of this study was to investigate the effects of an epistemic cooperation script on the amount of discourse, information seeking and individual learning outcomes in collaborative learning. More specifically, the following research questions were addressed:

Research question 1: *What effects does an epistemic script have on the amount of discourse in collaborative learning compared to unscripted collaborative learning?*

Based on the uncertainty reduction theory the following hypothesis was formulated. Hypothesis 1: *The epistemic script will increase the amount of discourse.* Based on the uncertainty reduction theory, we assume that it may be possible to reduce uncertainty by providing a specific task strategy with an epistemic script. Therefore, we expected that the epistemic script would increase the amount of discourse.

Research question 2: *What effects does an epistemic script have on the amount of information seeking in collaborative learning compared to unscripted collaborative learning?*

Hypothesis 2: *The epistemic script will reduce information seeking.* According to the uncertainty reduction theory, low uncertainty decreases information seeking. The theory also predicts that in highly uncertain situations participants seek more information. As the epistemic script is expected to reduce uncertainty, we assumed that the epistemic script would also lessen information seeking.

Research question 3: *What effects do epistemic scripts in collaborative learning have on individual learning outcomes in comparison to unscripted collaborative learning?*

So far, the uncertainty reduction theory does not provide a basis for hypotheses on how uncertainty may be related to individual learning outcomes. Therefore, we formulate the following explorative research questions that will be addressed using a qualitative approach.

Research question 4: *How and what kind of information do learners seek?*

Research question 5: *How do learning partners react to information seeking?*

Research question 6: *How do information seekers react to the received information?*

<div align="center">Method</div>

Participants and design

The participants in this study were 48 students at the University of Munich in their first semester of educational sciences in an introductory course. The students were randomly grouped into triads (N = 16), and each triad was randomly assigned to one of the two experimental conditions. The first experimental condition was the *epistemic script* condition. The second experimental condition was the *unscripted* condition. Time-on-task was held constant in both conditions. In order to preserve anonymity, participants came from three different seminars and were given code names during the learning session.

The results regarding the individual learning outcome data were part of an earlier overview paper (Weinberger, Ertl, Fischer, & Mandl, in press). However, all process-related data as well as their qualitative and quantitative analyses are original and were not part of the Weinberger et al. overview.

Procedure

Students were placed in three separate rooms, and communicated with each other via the online learning environment. First, the students' prior knowledge was tested individually by means of a problem case. This test was used to control that the randomization was successful. Second, the students were given 15 minutes to read a text about Weiner's attribution theory (1985). Third, the online learning environment was shortly introduced to the students. Fourth, an 80-minute collaboration phase started. At the end of the session the students took a post-test based on another problem case.

Task and Experimental Conditions

Students worked together by applying theoretical concepts of attribution theory (Weiner, 1985) to three problems presented in the online environment. These three authentic cases were the central elements in the online learning environment (see Figure 1 for a complete description of the "Math case"). The "Class case" described a teacher who

explained poor performance in natural sciences based on gender, and the "Asian case" asked to interpret school performance differences between Asian and American/European students using the attribution theory.

Insert Figure 1 here

Students analyzed and discussed the problems via online discussion boards within the groups of three students. In the online environment there were three online discussion boards, one for each problem.

The collaborative learning session in each condition lasted for 80 minutes. In the unscripted condition students were not provided with support to solve the three cases. In the epistemic script condition, participants were guided to apply theoretical concepts to problems with the help of prompts (see Figure 2). The prompts were meant to support the participants in identifying of the relevant problem information and applying the concepts of the attribution theory to the given problem information. They included questions and proposals for pedagogical interventions regarding the problem.

Insert Figure 2 here

Online Learning Environment

The online learning environment can be used via the World Wide Web (WWW), and it is built on standard html-format web-pages. The environment is a password protected website in which three learners can post messages (see Figure 3). In the upper left corner of the screen

learners find a task description and a timer, which can be modified and adapted to different settings of the learning environments.

Insert Figure 3 here

In the lower left corner there is a map of the three discussion boards, which should facilitate orientation. The current discussion board is marked with a red X. On the screen, there is also a description of the problem cases. Below the case information a text message can be typed in text windows. In the epistemic script condition the text windows of initial messages are pre-structured with prompts, to which learners are supposed to react (see Figure 3). After learners have sent in their contributions they can access an overview page of the individual online discussion boards. Discussions form a threaded structure in the overview page, which is typical for standard discussion boards.

Data Sources and Instruments

The written discussion data consisted of 16 group discussions (including three problem solving cases) from eight groups in two different conditions. We approached the data both quantitatively and qualitatively. Both quantitative and qualitative approaches as well as theory-based and data-driven approaches may complement each other (Häkkinen, Järvelä, & Mäkitalo, 2003). The use of different methods allows the researcher to examine different facets of a phenomenon in a more holistic way (Tashakkori & Teddlie, 1998). The data was aggregated and analyzed at the group level.

First, we segmented the discourse corpora into propositions. Agreement between two coders in identifying these units of analysis was acceptable (K = .72). In the quantitative procedure we used word counts of all messages within groups in order to measure the amount

of discourse. Information seeking was analyzed with the help of the social modes of co-construction dimension in the "Coding system of a multi-level analysis of knowledge co-construction" (Weinberger, Fischer, & Mandl, 2002; K = .81). If a learner aimed to get a response from the learning partners, this attempt was classified as information seeking. This is typically done by asking questions, for example, "What do you mean by that?"

The post-test based on a problem case measured individual learning outcomes. The problem case involved a university student who failed a course, a first for him and explained his poor performance with a lack of talent, while the 50 % of the students failed on that course. Students were given 10 minutes to analyze shortly the problem case without Weiner's theoretical text. Several concepts of attribution theory were needed to solve the individual problem cases. Applicable knowledge was measured on the basis of the amount of adequate relations between theoretical concepts and case information in the solution. The relations between theoretical concepts and case information were identified as adequate with respect to the theoretical text and an expert solution. Six central relations between theoretical concepts and case information were identified for the students' post-test analyses. These six central relations were 1) A failure precedes the attribution, 2) "A lack of talent" is an internal attribution, 3) "A lack of talent" is a stable attribution, 4) "A lack of talent" is an attribution on ability, 5) "Talent" equals ability and, 6) "50% failures" can be attributed to task difficulty. The effects of the epistemic script on the amount of discourse, information seeking and individual learning outcomes were tested for statistical significance with a t test for unpaired samples. The α-level was set to 5% for every t test.

We also studied the ongoing discourse with the help of case-based analyses. Two case-based analyses from different conditions were chosen for more detailed qualitative analysis.

The discourses were translated from German to English, and the written mistakes and format were kept as similar as possible in comparison to the original discourse.

The qualitative analysis was partly theory driven (Berger & Bradac, 1985; Berger & Calabrese, 1975; King, 1999; Webb, 1989) and partly data driven. We narrowed our focus of the qualitative analyses of both case-based analyses to information seeking processes only. The information seeking units were identified by quantitative analysis, while the qualitative content analysis was completed in exploring both the way learners seek information and the type of information they seek. We also investigated the way in which the learning partners react to information seeking and how information seekers react to the received information. This approach preserves the group as the primary unit of analysis (Barron, 2003). By focusing on the group, we explored interaction that captures the dynamic interplay of information-seeking discourse between the participants and the types of contributions they make. At the first round, we found out four different information seeking types: seeking 1) facts (e.g., "*Where does the information in the newspaper come from?*"), 2) ideas (e.g., "*Do you have an idea here?*"), 3) opinions (e.g., "*Do you think that this is part of it?*") and, 4) verifications (e.g., "*But isn't it actually about the laziness of the boy?*"). Further, we identified two different ways to seek information. The direct way for seeking information was asking questions (e.g., "*What do you mean by that?*"). Participants also used indirect information seeking and they did it mostly by isolated question marks (e.g., "*????*") or claims followed by a question mark in brackets (e.g., "*Stable. (?)*"). Two types of reactions were defined, response (a reply) and no response (no reply) at all. Finally, the analysis focused on the response to received information, if information seekers elaborated on the offered information.

Results

In this section, the quantitative results will be presented. Subsequently, the case-based analyses will be portrayed.

The Amount of Discourse, Information Seeking and Individual Learning Outcomes

Our first research question was to study the effects an epistemic script has on *the amount of discourse* in collaborative learning compared to unscripted collaborative learning. The amount of discourse was higher in the epistemic script condition than in the unscripted condition (see Table 1). A *t* test revealed a significant effect for the epistemic script, $t(15) = -2.67$, $p < .05$ (one-tailed). As expected, the epistemic script increased the amount of discourse.

Insert Table 1 here

The second research question was to study the effects that an epistemic script has on *information seeking* in collaborative learning in comparison to unscripted collaborative learning. The results show that learners sought information in the epistemic script condition less often than in the unscripted condition (see Table 1). A *t* test revealed a marginally significant effect of the epistemic script, $t(15) = 1.57$, $p < .10$ (one-tailed). These results only partly support the hypothesis that the information seeking scores should be lower in the epistemic script condition, and such findings should be interpreted with caution.

Finally, the results show that *individual learning outcomes* were higher in the unscripted condition than in the epistemic script condition (Figure 4). There were significant differences between the learning outcomes in the unscripted condition in comparison with the epistemic script condition, $t(15) = 2.50$, $p < .05$ (two-tailed).

Insert Figure 4 here

Case-based Analyses on Information seeking

Two case-based analyses were conducted to further explore the relation of information seeking and learning. The qualitative analysis focused on exploring how and what kind of information learners seek and how learning partners react to the information seeking and the received information. The selection of these two cases (one of each condition) is based on the quantitative results with respect to the amount of discourse, information seeking and individual learning outcomes. The epistemic script group of three students represents a typical case with a high amount of discourse (number of words), but low individual learning outcomes. The unscripted group of three students was selected for its high level of information seeking and high individual learning outcomes.

Every excerpt is attached with information on which of these three problem cases were involved, the order number of the message, the time the message was sent and by whom (see Figure 5; *explanation is in italics*). A previous message, when was included in the new message by the sender, is marked with a '>' at the beginning of the sentence. Original and new messages have no marks, except the line numbers. The prompts that are included in epistemic script conditions are shown in capital letters.

Insert Figure 5 here

The sentences that are referred to in the analyses are marked in italics in the excerpts. In order to improve readability, the messages are also cut short, which is marked with three dots.

Unscripted group. This group sent 88 messages during the conference in three different online case boards. In the Math case board there was a total amount of 46 messages, in the Class case board 29 and in the Asian case board 13 messages. The unscripted group started to work at 14:53, and the first message was sent to the Math board after 11 minutes from the start. The last message was sent to the Class case board at 15:13.

In the unscripted group, the members sought information by using questions. The questions focused on seeking ideas (see Excerpt 1, line 1) and verifications (Excerpt 2, line 4). In Excerpt 1, Birgit pointed out that time was running short, and she requested that the learning partners explore some new *ideas* to solve and complete the math case.

Excerpt 1. M33; 14:22:13; Birgit

1. (Half the time is nearly gone!) *Can you think of anything else about this analysis?...*

There were also questions focusing on *verifying* definitions (see Excerpt 2, line 4). This particular discussion thread (includes Excerpts 2-6) presents how one of the learning partners was seeking verification (Excerpt 2, line 4), how the other learning partner was responding to information seeking (Excerpt 3, lines 1-2) and how the information seeker was reacting to the received information (Excerpt 4, line 1). This example also shows how the learning partner had offered the information reacted the information seeker's response (Excerpt 5, line 1) and how the third learning partner was also joining into the discourse by elaborating the offered information (Excerpt 6, line 1). The participants were discussing the internal stable attribution. Maria doubted (see line 3-4) that one could diagnose an internal stable attribution in this case and she wanted to verify definitions and see if Stefanie shared her point of view (see lines 1-2).

Excerpt 2. M23; 14:04:13; Maria

…

1.>So Michael gives a reason for his bad math by an internal, stable attribution, so he is

2.>just not as able as his parents.

3. *I think that Michael doesn't blame himself, but his inherited genes.*

4. *Can you really label this as an internal stable attribution?*

In her reply, Stefanie backed up her earlier statement and explained the reason why it can be

seen as an internal stable attribution (see Excerpt 3, lines 1-2).

Excerpt 3. M24; 14:10:26; Stefanie

1. *Yes, you can. He says he isn't talented and talent is an internal cause.*

2. *Which is stable. You can't assume that he will be more talented later.*

Maria supported and accepted Stefanie's explanation, and then she pointed out a new issue by

mentioning training (Excerpt 4, lines 1). In her reply, she elaborated the received information.

Excerpt 4. M25; 14:15:37; Maria

1. *Yes, that's right! Unless training would make him see that his bad performance in*

2. *math doesn't attribute to talent.*

After this, Stefanie supported and accepted Maria's idea about the training (Excerpt 5, line 1).

Excerpt 5. M26; 14:24:00; Stefanie

1. *That is finally a good idea. He should simply do reattribution training.*

Birgit was also joining the discussion, adding another issue concerning the training and the parents (Excerpt 6, line 1). In the ongoing discourse she used the opportunity to elaborate the received information sought by the other group member.

Excerpt 6. M27; 14:29:41; Birgit

1. *And so should the parents.*

In another situation, Stefanie states that she did not understand an internal stable attribution of others (see Excerpt 7, lines 3-4), which was mentioned by Maria. She was making reference to Maria's earlier message (lines 1-2).

Excerpt 7. C9; 14:44:18; Stefanie

1.>In this case, I would talk about internal stable attribution of others, which of course.

2.>expands – to self attribution. Finally the girls adopt the public opinion.

3. *What about an internal stable attribution of others?*

4. *I don't understand that*

It was Birgit who was replying to Stefanie's message and explaining to her about the attribution of others (Excerpt 8, lines 1-5).

Excerpt 8. C10; 14:52:53; Birgit

1. *You are right. I think that there isn't one anyway.*

2. *Attribution from the parents and teachers, who encourage the girls in their opinion*

3. *that they are not as talented as the boys. This becomes internal stable self-attribution*

4. *and can probably be solved – according to attribution theory – with reattribution*

5. *training.*

In summation, this group sought information by asking questions regarding ideas and verifying definitions. The learning partners reacted to information seeking by responding to a message. The information seekers, but also learning partners who were not seeking this information in the first place responded to the received information by elaborating it. The information seeking processes of this group included information request, response and reception.

Epistemic script group. This group sent 27 messages during the conference in three different case boards. In the Math case board there was a total of 11 messages, in the Class case board 7 and in the Asian case board 9 messages. The first message was sent at 14:12 to the Math case board, but during this 80-minute online conference the messages appeared irregularly in different boards. The last message was sent to the Class case board at 15:20. In this group, with the help of prompts (see Figure 1), the learners analyzed the cases and used the prompts regularly.

Here the members were seeking facts (Excerpt 9, lines 1-2), ideas (Excerpt 10, line 1), opinions (Excerpt 11, line 5), and verifications (Excerpt 12, line 2). In Excerpt 9 (lines 1-2), Susanne sought *facts* by asking where the information was available and who the writer of the newspaper article was.

Excerpt 9. C4; 14:33:10; Susanne

…

1. *Where does the information in the newspaper come from?*

2. *Who has said this?*

Julia analyzed the Math case, but apparently she was not able to respond to the last prompt, which asked for case information that cannot be explained with the attribution theory, so she asked if her learning partners had any *ideas* (see Excerpt 10, line 1).

Excerpt 10. M1; 14:12:37; Julia

…

1. *do you have an idea here? i do not so far! i am looking forward to answers*

In Excerpt 11 (see line 3), Julia asked if her learning partners shared the *opinion* about training that cannot be explained with the attribution theory.

Excerpt 11. C3; 14:32:35; Julia

1. girls are thinking about their abilities different from boys!

2. reinforced by parents and teachers!

3. training with girls: *do you think that this is part of it?*

Katrin wanted Susanne to explain why she had referred to a stable attribution in her previous message and added her own opinion that the attribution was more variable in this

case (see Excerpt 12, 1-3). Despite this clear disagreement uncovered by Katrin, Susanne did

not reply to this *verification* question.

Excerpt 12. M5; 15:03:30; Katrin

1. I thought he was more skeptical than really excited.

2. *But isn't it actually about the laziness of the boy?* You can stop the laziness and so

3. it is variable.

The group members seemed to adopt different styles to seek verifications. They were

using question mark after claims or isolated question marks without any sentence (see Excerpt

13, lines 1 and 4 and Excerpt 14, lines 4 and 6) for seeking verifications from the others

instead of using direct questions.

Excerpt 13. M3; 14:21:03; Susanne

…

1. Internally: Michael thinks math is not his thing, *lack of interest (?)*.

2. CASE INFORMATION WHICH CANNOT BE EXPLAINED WITH THE

3. ATTRIBUTION THEORY:

4. *????*

Excerpt 14. A4; 14:52:28; Katrin

1. CASE INFORMATION WHICH CAN BE EXPLAINED WITH THE

2. ATTRIBUTION THEORY:

...

3. But all children are equally gifted. *Asians are thinking that reasons are temporally*

4. *stable(?).*

…

5. - IS THE CAUSE FOR THE ATTRIBUTION STABLE OR VARIABLE?

6. *Stable. (?)*

...

Excerpt 10 includes an example of seeking ideas and Excerpt 15 illustrates how the

learning partners reacted to this question. In Excerpt 10 (line 1) Julia analyzed the Math case

using every prompt in the intended manner, except for the last one. At the last prompt she

sought ideas by asking her learning partners if they had any ideas on this topic. The question

also included an invitation to joint discourse, as she told she was looking forward to reading

about their ideas (Excerpt 10, line 1). Julia's question ("Do you have an idea here?") did not

lead the discourse any further towards ideas on the prompt "case information which cannot be

explained with the attribution theory". Instead, one of the learning partners reminded them on

organizational issues (See Expert 15, lines 1-2).

Excerpt 15. M2; 15:07:31; Katrin

1. *Hi guys, we need a summary!!!!!!!!!!!!!!!!!!!!!!*

2. *I will quickly write something for this case, won't I!*

Katrin announced that they needed to quickly write a summary (see line 1), because the time

was up. This response did not offer any relevant information for Julia's information seeking.

The third member did not even reply to Julia's request.

In Excerpt 16 (lines 3 and 6) Susanne was doing an analysis about the Asian case, and she did not present any direct questions, but used question marks at the end of a phrase and then at the end of the last prompt. She got two replies for that message, one from Katrin (Excerpt 17, lines 1-4) and one from Julia (Excerpt 18, lines 1-22). Both answers were connected to the content of the previous message.

Excerpt 16. A1; 14:43:07; Susanne

…

1. RELEVANT TERMS OF THE ATTRIBUTION THEORY FOR THIS CASE:

2. - DOES A SUCCESS OR A FAILURE PRECEDE THIS ATTRIBUTION?

3. *Success, isn't it?*

...

4. CASE INFORMATION WHICH CANNOT BE EXPLAINED WITH THE

5. ATTRIBUTION THEORY:

6. *?*

Katrin complained about the case description (Excerpt 17, line 1), but she agreed on the success of Asian children and the reasons as to their success. She also mentioned that the instructional approaches may be better in Asian countries. It seemed that Katrin was not directly responding to Susanne's indirect questions (question marks), and she ignored the last question, which concerned case information that cannot be explained by the attribution theory.

Excerpt 17. A2; 14:57:19; Katrin

1. *The text is shit, isn't it? But I have to agree that in the Asian countries much*

2. *more effort shows in comparison to us for example they certainly give*

3. *much more thought on pedagogy and they know that one has to praise children for*

4. *them to be more successful. Probably they won't have to do reattribution.*

Comparing to Katrin's response, Julia commented on most of the ideas Susanne was presenting (Excerpt 18, lines 6, 10-11, 14, 18 & 22). With respect to the second prompt, Julia declared that she was not sure about the idea of success (see lines 10-11), but nobody continued on this point. She also directly posed the question, "*What do you mean by that?*" (line 14) but she never got a reply from Susanne. Julia replied to Susanne's question mark in the last prompt at the end of the message by just mentioning that she did not have an idea on that issue either (see line 22). This example may be seen to indicate that the learning partners did interpret the isolated question marks as information seeking. In this group this kind of indirect information seeking was not very successful, however, as the learning partners responded by offering non-relevant information or did not respond at all.

Excerpt. 18. A3; 15:04:49; Julia

1.>CASE INFORMATION, WHICH CAN BE EXPLAINED WITH THE

2. ATTRIBUTION THEORY:

3.>How do the parents and pupils explain success and failure in scientific subjects?

4.>Asian parents and children have more favorable attribution patterns as far as the

5.>dimension of stability is concerned.

6. *i could not formulate it better!*

7.>RELEVANT TERMS OF THE ATTRIBUTION THEORY FOR THIS CASE:

8.>- DOES A SUCCESS OR A FAILURE PRECEDE THIS ATTRIBUTION?

9.>Success, isn't it?

10. *i think it's both success of the Asian children and failure of American and European*

11. *children. But I am not fully sure which success is meant*

…

12.>- IS THE CAUSE FOR THE ATTRIBUTION STABLE OR VARIABLE?

13.>stable, it was mentioned in the text

14. *what do you mean by that? where was it mentioned?*

15.>- DOES THE CONCERNED PERSON ATTRIBUTE HIMSELF/HERSELF OR

16.>DOES ANOTHER PERSON ATTRIBUTE HIM/HER?

17.>He is attributed. The others are searching for a reason for good achievements.

18. *exactly! There has been a study on that*

…

19.>CASE INFORMATION WHICH CANNOT BE EXPLAINED WITH THE

20.>ATTRIBUTION THEORY:

21.>?

22. *in this regard I don't have any special idea either*

There were direct information seeking moves such as, "*What do you mean by that?*" (Excerpt 18, line 14), or "*But isn't it actually about the laziness of the boy?*" (Excerpt 12, line 2) which can be seen as opportunities to deepen the discourse at the epistemic level, but the learners hardly noticed these opportunities.

In summary, the participants of the epistemic script group sought various forms of information such as facts, ideas, opinions and verifications. They sought information

indirectly, and hardly responded to information seeking activities of their learning partners. Therefore, the information seekers did not have a chance to receive and elaborate the information.

Discussion

Based on the uncertainty reduction theory, two hypotheses have been tested on how the levels of uncertainty in scripted and unscripted collaborative learning conditions affect the amount of discourse and information seeking. Furthermore, two conditions of collaborative learning with varying degrees of uncertainty have been analyzed with regard to individual learning outcomes. The findings support our hypothesis that the amount of discourse will increase in the epistemic script condition, as suggested by the uncertainty reduction theory. As also hypothesized, information seeking decreased in the epistemic script condition. The marginally significant effect of the epistemic script on information seeking may be cautiously interpreted as supportive to the hypothesis. With respect to individual learning outcomes, the results further indicate that the unscripted uncertainty condition improved learning outcomes.

The pattern of results could be regarded as implying that learning environments should provide some degree of uncertainty. With respect to the uncertainty reduction theory, results suggest that uncertainty is not always a barrier to successful interactions. Our study shows that some degree of uncertainty with regard to the task may actually enhance learning compared to a highly certain situation. An explanation for this effect might be that uncertainty facilitates beneficial interaction patterns, which includes information seeking. In collaborative learning, information seeking can improve discourse when learning partners are responding to information seeking and acting appropriately when receiving information. This kind of discourse pattern is known to enhance individual learning outcome (e.g. King, 1999; Webb, 1989). The qualitative case-based analyses provided some insights that may inform the

formulation of hypotheses for future research. While both groups sought various forms of information, such as ideas and verifications, they took different steps with respect to information seeking, responding to information seeking and receiving information. In this study the unscripted group sought information in a direct and successful manner, while the scripted group sought information more indirectly and less successfully. Participants in the epistemic script group were less active in responding to information seeking. Indirect information seeking with respect to the terminology or the ideas was not successful, as the learning partners were not reacting to them. Therefore, there was little information for the information seekers to receive and elaborate. Participants in the unscripted group, in contrast, sought information more directly by clearly indicating their lack of understanding. They responded to information seeking by providing the information, ideas or verifications that had been asked for. Moreover, the learning partners of the unscripted condition discussed the terminology and definitions more often than the epistemic script group did. The participants in the unscripted group also elaborated the received information. It should be noted, that using a combination of qualitative and quantitative analyses helped in obtaining detailed information regarding processes of online interaction and in revealing unexpected results of the pedagogical structuring of online learning.

A potential limitation of the study, however, is that no subjective measure of uncertainty was used. Therefore, the assumption that the script reduced the subjectively experienced uncertainty cannot be directly supported by the data. Further research should include subjective measures of uncertainty. Uncertainty measurement approaches are used, for example, in social psychology (Budescu, Rapoport, & Suleiman, 1990; Gärling, Biel, & Gustafsson, 1998) and in the clinical and health policy (Balsa, Seiler, McGuire, & Bloche,

2003; McCormick, 2002). These approaches might be adapted to applications in the field of collaborative learning in higher education and online learning contexts.

Another possible shortcoming of the study is the operationalization of uncertainty, as the control condition included a number of structural elements (e.g., task description, cases, theory text, threaded discussion boards) that themselves might have substantially reduced uncertainty. There are online environments with much less structured task descriptions and we cannot rule out the possibility that the used epistemic scripts would have more positive effects there. Another possible limitation with respect to the epistemic script might be that it perhaps restricted the learners too much, in the sense that its prompts were rather closed questions and therefore not very strong in facilitating elaborative processes (see Dillenbourg, 2002, for a discussion on the notion of coercion). Future research may focus on multiple and more extreme levels of uncertainty to further explore a presumably non-linear relationship between uncertainty or degrees of freedom in an online collaborative learning environment and individual learning outcomes.

A final limitation worth mentioning might be the focus on the cognitive aspects of processes and outcomes. Crucial problems concerning interaction in online learning environments may also occur at the social and emotional levels (see also Gunawardena, 1995). Kreijns, Kirschner, Van Buuren and Jochens (2004) point out that the sociability, that is to say, how well the online environments can facilitate the emergence of social space will be one crucial contribution to the success of online learning. These are the aspects which need further studies in online learning, but which also can be enriched with the theoretical and empirical analyses of uncertainty reduction theory.

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Figure Caption

Figure 1. One of the three problem cases (Math case).

Figure 2. Prompts of the epistemic script to apply the concepts of the attribution theory of Weiner (1985) to the problem cases.

Figure 3. The learning environment with orientation map, case description, and text window with prompts.

Figure 4. Means and standard deviations scores of individual learning outcomes in unscripted and epistemic script conditions.

Figure 5. Explanations of the abbreviations and format aspects of the excerpts which are presented in the case-based analysis.

You participate in a school counselling as a student teacher of a high school with Michael Peters, a pupil in the 10th grade.

"Somehow I begin to realize that math is not my kind of thing. Last year I almost failed math. Ms Weber, who is my math teacher, told me that I really had to make an effort if I wanted to pass 10th grade. Actually, my parents stayed pretty calm when I told them. Well, mom said that none of us is 'witty' in math. My father just grinned. Then he told that story when he just barely made his final math exams with lots of copying and cheat slips. 'The Peters family', Daddy said then, 'has always meant horror to any math teacher.' Slightly cockeyed at a school party, I once have told this story to Ms Weber. She said that this was bad excuse, but good one either. Just an excuse that is, and you could come up with some more to justify to be bone idle. Last year barely made it, but I am really anxious about the new school year!"

Case information, which can be explained with the
attribution theory:

Relevant terms of the attribution theory for this case:
- Does a success or a failure precede this attribution?
- Is the attribution located internally or externally?
- Is the cause for the attribution stable or variable?
- Does the concerned person attribute himself/herself or
does another person attribute him/her?

Prognosis and consequences from the perspective of the
attribution theory:

Case information which cannot be explained with the
attribution theory:

Ihre Aufgabe:
Diskutieren Sie die drei Fälle vor dem Hintergrund der Attributionstheorie und erstellen Sie mindestens eine abschließende Analyse zu jedem Fall!

Schreiben Sie eine erste Analyse des Falls Asien mit Hilfe der inhaltlichen Checkliste!

Zeitvorgabe: 16 Minuten

Davon verbleiben noch 4 Minuten

Fall
Asien

Ende
Fall
Mathe

Ende
Fall
Klassen-
treffen

Fall Asien

In einem Seminar erfahren Sie von einer Studie, in der festgestellt wurde, dass asiatische Kinder gegenüber amerikanischen und auch europäischen Kindern wesentlich bessere mathematische Leistungen erbringen. Interessanterweise zeigte sich auch, dass sich die asiatischen Kinder hinsichtlich ihrer Begabung kaum von den amerikanischen und europäischen Kindern unterschieden. In der Studie hat man dann sowohl die Schüler, als auch deren Eltern befragt, wie sie sich Erfolg und Misserfolg in naturwissenschaftlichen Schulfächern erklären. Dabei hat sich gezeigt, dass die asiatischen Eltern und Kinder vor allem günstigere Attributionsmuster im Hinblick auf die Dimensionen der Stabilität haben. Wie lassen sich die Leistungsunterschiede aus der Perspektive der Attributionstheorie erklären?
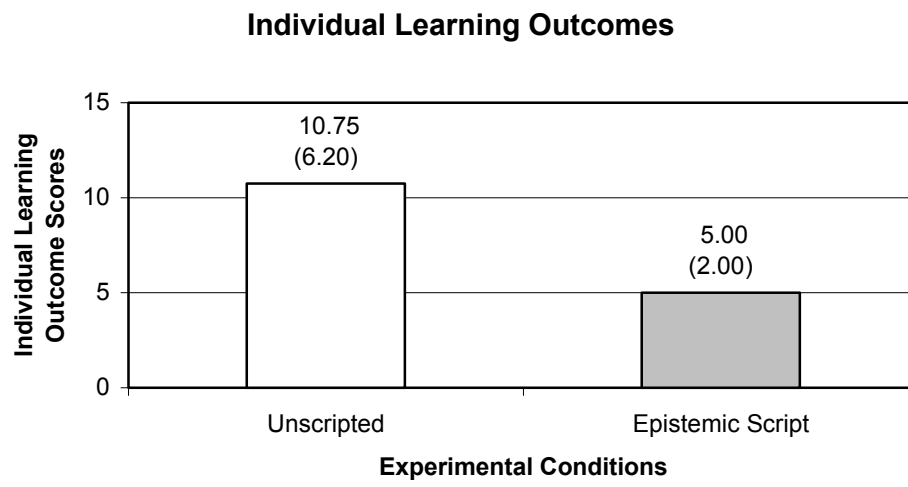
```
MIT DER ATTRIBUTIONSTHEORIE ERKLÄRBARE FALLINFORMATIONEN:


FÜR DIESEN FALL RELEVANTE BEGRIFFE DER ATTRIBUTIONSTHEORIE:
- GEHT DER ATTRIBUTION EIN ERFOLG ODER EIN MISSERFOLG VORAUS?

- IST DIE LOKALITÄT DER ATTRIBUTION INTERNAL ODER EXTERNAL?

- WIRD AUF EINE STABILE ODER EINE VARIABLE URSACHE ATTRIBUIERT?

- ATTRIBUIERT DER BETROFFENE SELBST ODER WIRD VON AUßEN FREMD
ATTRIBUIERT?


PROGNOSE UND PÄDAGOGISCHE KONSEQUENZEN AUS DER PERSPEKTIVE DER
ATTRIBUTIONSTHEORIE:


NICHT MIT DER ATTRIBUTIONSTHEORIE ERKLÄRBARE FALLINFORMATIONEN:
```

Individual Learning Outcomes

Figure. Bar chart showing Individual Learning Outcome Scores (y-axis, 0 to 15) for two Experimental Conditions (x-axis). Unscripted condition: 10.75 (6.20). Epistemic Script condition: 5.00 (2.00).

Excerpt X. **M** (*the letter code addresses different cases*; *M= Math case, A= Asian and C= Class case*) **23** (*the order number of message in the particular case discussion board meaning, for instance, the 23rd message that has been sent in this discussion board*); **14:04:13** (*time when the message was sent*); **Maria** (*and by whom*)

1..>So Michael gives a reason for his bad math by an internally, stable

2. >attribution, so he just not as able as his parents. The teacher's opinion is that

3. >it is just laziness = internal variable effort

(*the '>'-mark indicates that the previous message is being quoted*)

… (*three dots mean that a part of the original message has been left out*)

4. I think that Michael doesn't blame himself, but his inherited genes.

5. Can you then really label this as an internal stable attribution?

(*the original message has no marks, except the line numbers*)

(*line numbers help to point out the important allusions*)

Table 1

Means and standard deviations for the amount of discourse and information seeking in the

unscripted and the epistemic script groups

Groups	*Unscripted*		*Epistemic Script*	
Variable	*M*	*SD*	*M*	*SD*
Amount of discourse	17.44	4.95	24.85	6.10
Information seeking	6.75	5.85	3.00	3.38