Fostering argumentation with script and content scheme in videoconferencing

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Abstract: This study examines the support of argumentation in collaborative task solving in videoconferencing. In particular, it investigates the effects of a script (which supported the collaboration) and a content scheme (which fostered the focusing on the content) on transactivity in argumentation and on justifications of single arguments in the learning discourse and task solutions. Learners were asked to learn a theory individually before working on a task cooperatively. Altogether, 52 triads were randomly assigned to one of four conditions in a 2 (with/without script) x 2 (with/without content scheme)-factorial design. To measure the effects of the intervention, the argumentation in the learning discourse and in the task solutions was analyzed. Results show no effects of the script on transactive reactions, but small effects of the content scheme. The content scheme also influenced the construction of arguments with justifications positively. Justifications in task solutions were supported by script and content scheme.

Introduction

Argumentation is an important ability in everyday life and scientific work. To justify a point of view, to compare different opinions and thus achieve an integration or arrive at a conclusion is a main antecedent for deciding on difficult tasks. Argumentation is defined as "a verbal and social activity of reason aimed at increasing (or decreasing) the acceptability of a controversial standpoint for the listener or reader, by putting forward a constellation of propositions intended to justify (or refute) the standpoint before a rational judge" (Van Eemeren, Grootendorst, & Henkemans, 1996, p. 5). In scientific discourse, argumentation is a very important ability for establishing diverse perspectives in collaborative task-solving by confronting cognitions and their foundations (Andriessen, Baker, & Suthers, 2003). These perspectives comprise different knowledge, information or points of view which are necessary for solving an interdependent task collaboratively (Jonassen, 2000). In this collaborative discourse, argumentative activities are necessary. These imply that group members have to disseminate their different points of view on the task, that they exchange their knowledge about it and discuss task-relevant aspects.

Argumentation in collaboration

Regarding argumentation in collaboration, there are especially two aspects relevant: transactive reactions and justifications in single arguments. These are explained in the following two chapters.

Transactive reactions in argumentation

Looking at argumentation as discursive exchange of different opinions between collaborating partners more closely (Leitao, 2001), it is important how collaborating partners react to each other argumentatively in joint task-solving. In argumentation, one action and three reactions are important (Leitao, 2000): Statements as action, and confirmations, counter-arguments and replies as reactions. The reactions can follow on statements, but also on other reactions. The processes behind these action and reactions are the following. In the first step, people have to elaborate their own point of view to start argumentation in collaboration (statements). Secondly, the collaborating partners have to cognitively process the explanations and elaborations they heard, compare them with their own point of view and draw a conclusion concerning their reaction on it. This could for example be a confirmation and a counter-argument. Confirmations show the agreement with a point of view, while counter-arguments express a different point of view (Leitao, 2000; 2001). The third kind of reaction includes a reply (Leitao, 2000), which could be an integration of different points of view, an evaluation or conclusion of the argumentation. The activities behind replies are based on comparing and evaluating the different points of view and on drawing a conclusion concerning the most adequate argumentation. Argumentative action and reactions can permanently alternate due to the dynamic in collaboration. Regarding reactions in argumentation, there are particularly two kinds of reactions possible: one in which collaborating partners refer their utterance to a previous assertion of another member of the group and one in which they do not relate their opinion to former statements. The first reaction is classified as transactive. A reaction is "considered transactive when it extends paraphrases, refines, completes, or critiques the partner's reasoning or the speaker's own reasoning" (Teasley, 1997, p. 362). Transactivity is one important characteristic of argumentation because by relating utterances to other people, the discussants' cognitive processing is shown.

Research in the field of argumentation regarding transactivity was investigated by Leitao (2000). In a study with two real groups, she qualitatively analyzed the argumentative discourse concerning the validity of argumentation and the kind of argumentative reactions of group members according to the categories statement, confirmation, counterargument and reply. Results showed that the discussants modified or specified their opinions during argumentation, but did not give them up in favor of a counter-argument. Other studies focused on transactive reactions in a quantitative way. In a study by Berkowitz and Gibbs (1983), individuals who reacted more frequently in a transactive way to each other during discussion changed their moral points of view more often, too. Thus, transactive reactions may evoke deeper cognitive processes of elaboration and reflection, so that individuals improve their own argumentation. Therefore, it is important to analyze these elements of argumentation during collaboration.

Regarding such discourse elements in argumentation, for many people it is difficult to formulate statements, to confirm and refuse them (Kuhn, Weinstock, & Flaton, 1994) or to reply in an integrative or deductive way with the aim of solving a task collaboratively. First, people often do not elaborate and justify their points of view so that their collaborating partners are able to understand their arguments. Second, the reaction to these statements requires complex processes of comparing one's own opinion with the uttered opinion. And third, coming to an integration or conclusion due to an evaluation process of all different points of view necessitates meta-cognitive abilities, which are difficult to perform (Dansereau, 1988). Therefore, people need support in their argumentative collaboration. One possible method comprises the structuring of this collaboration.

Justifications in argumentation

Apart from transactivity, a second aspect concerning argumentation refers to the justifications of single arguments. Referring to logical reasoning, arguments comprise two components: premises and conclusions (Fisher, 1988). In this context Kuhn (1991) defines arguments as "assertions with accompanying justification" (p. 12). Therefore, an argument is a meaningful expression to support another utterance (Andriessen et al., 2003). Justifying points of view is a main antecedent for convincing collaborating partners of the correctness and adequacy of arguments. In collaboration, learners not only have to take their own reasoning into consideration, but also the externalized statements of their collaborating partners. Therefore, learners not only have to reflect on their own argumentation, but also on their collaborating partners' argumentation. The antecedent for correct justifications in arguments is the concentration on adequate and relevant content. A main problem in this context concerns the fact that people often do not justify their points of view at all, but simply put forward claims and hypotheses (Kuhn, 1991). In scientific task solutions, theory and evidence must both be considered and related to each other (Kuhn, Schauble, & Garcia-Mila, 1992). Focusing on these two aspects is very challenging for learners. Furthermore, if learners do not know which content they should stress, they will not be able to justify their arguments in the intended direction. In this context it is helpful to support learners focusing on the content.

To sum it up, many studies show that people often do not argue in collaboration in an adequate and logical way. For collaborating partners exchanging arguments transactively in collaboration and constructing logical arguments with justifications is often difficult and it is due to the lack of such abilities that support is necessary.

Fostering collaborative argumentation in videoconferencing

In settings of computer-based learning argumentation can be fostered by the design of learning environments. In concrete terms this means that the computer is used as external knowledge representation which could be structured in such a way that argumentation is fostered (Andriessen, et al., 2003). In this contribution, we focus on indirect support methods fostering the interaction and discussion of collaborating partners and thus also argumentation only implicitly (Van Bruggen, & Kirschner, 2003). These methods rely on the computer as external knowledge representation tool. In computer-mediated communication, learners mostly have to solve a task together by using the computer for externalizing their knowledge and for recording their task solution which implicitly influences argumentation both in transactive argumentation and in justifications of arguments. In respect to transactive argumentation, the representational tools can have two effects: First, the explication of different points of view is initiated (Munneke, Van Amelsvoort, & Andriessen, 2003). Secondly, by representing ideas and different perspectives on the task in a shared way, the joint representation may function as external group memory that allows learners to refer to previous ideas (Van Bruggen, Boshuizen, & Kirschner, 2002). These references express transactive reactions. Concerning the justifications of arguments, the external representations activate processes of identifying components of arguments and of evaluating their consistency, accuracy or plausibility (Munneke, et al., 2003) which can improve the externalized knowledge.

Beyond these effects of representational tools for argumentation per se, there are further indirect instructional support methods for fostering transactive argumentation and the justifications of arguments, namely scripts and content schemes. These do not concentrate on the enhancement of argumentation directly, but are focused on strategic and content-specific aspects of the task collaboration. Strategic support could be realized by *scripts*. These structure the collaboration process itself with a pre-defined procedure, in which every step of the collaboration process itself is prescribed with sub-tasks. There are a lot of different definitions and application scenarios concerning scripts (Kollar, Fischer, & Hesse, in press). The term, usually taken from cognitive psychology (Schank, & Abelson, 1977), is increasingly used in CSCL learning environments as instructional support method (see Fischer, Kollar, Mandl, & Haake, 2007). In this context, scripts mainly sequence collaboration and assign specific activities to the learners (Ertl, Kopp, & Mandl, 2007).

In videoconferencing, scripts focus on the assignment of specific tasks to foster the application of collaboration strategies. These tasks aim at the learners exchanging information, replicating important information and reflecting about the relevance of the tasks for their collaborative task solution (Reiserer, 2003). Two videoconferencing studies show a positive effect of the script intervention on the learning discourse (Härder, 2004; Reiserer, 2003). Yet, it is not investigated whether this effect also concerns transactive reactions in argumentation during the collaboration process, the justifcations of arguments, and the justification of collaborative and individual task solutions. As scripts foster the exchange of information as well as the discussion and reflection on it, they can also have an influence on transactive reactions in argumentation. Furthermore, focusing on information exchange may also effect that relevant information is used for justifying task solutions.

Content schemes represent and pre-structure the key concepts of a certain domain (Brooks, & Dansereau, 1983). This means that important content-specific components are labeled on a meta-level to focus learners on aspects which are relevant for the collaborative task solution. In CSCL learning environments, these content schemes are realized by pre-structuring the computer which is used as external representation. Potential realizations include tables (Reiserer, Ertl, & Mandl, 2002), matrices (Suthers, & Hundhausen, 2001) and maps (Fischer, Bruhn, Gräsel, & Mandl, 2002). The underlying assumption behind the support with content schemes is based on the theory that the visualization of main task-relevant aspects increases the learners' awareness of the content they are to focus on. In this context, the concept of 'representational guidance' is of importance (Suthers, 2003; Suthers, & Hundhausen, 2003) which refers to the salience of the task: Because the content scheme keeps the task-relevant components permanently salient, learners rely and focus on them.

Studies in videoconferencing scenarios often showed a beneficial effect of the content scheme on the collaboration discourse (Fischer, Bruhn, Gräsel, & Mandl, 2000; Reiserer, Ertl, & Mandl, 2002). However, it has not yet been investigated, whether the content scheme can foster argumentation and if so whether this effect then also shows in the collaborative and individual task solution. As content schemes stress main components of the task solution, they may influence argumentation in a way that different statements and counter-arguments are disseminated. In addition to this, making important aspects of the task salient may improve the justifications of arguments, which could become manifest not only in the learning discourse itself, but also in more justifications during the collaborative and individual task solution.

Although script and content scheme give first hints of beneficially influencing collaborative activities, it has to be asked whether the instructional support helps learners to justify their *task solution* more adequately. In this context, the collaborative and the individual task solution is relevant (Salomon, 1992). There are only few studies which focused on this aspect. For example Weinberger, Segmann, Fischer, and Mandl (2007) only found an effect of their script on the individual knowledge about argumentation sequences and about the structure of arguments, but not on the collaborative and individual task solution. Furthermore, there was no effect of scripts on the collaborative task solution either in a study by Baker and Lund (1997). The content scheme had also no clear effect on the collaborative task solution in a discussion (Kanselaar, Erkens, Andriessen, Veerman, & Jaspers, 2003; Suthers, 2003). Only the SenseMaker had a positive influence on the learners' individual concept of light (Bell, 1997; 2002). There are no clear effects of instructional support methods on task solutions. On top of this, there is no evident effect that the frequency of mentioning certain topics manifests itself in the collaborative task solution. For example, in a study by Andriessen, Erkens, Van de Laak, Peters, and Coirier (2003), learners who discussed a topic more frequently did not necessarily repeat it in their task solution. Consequently, there are no explicit data of instructional support methods that prove their effectiveness on justifications in task solution – neither on the collaborative nor on the individual task solution. Therefore, this is an important further research question.

Research questions

(1) How far do script and content scheme affect argumentation? Regarding argumentation as a twofold ability including transactive and reasoning processes, the effects of the support methods must be divided into two sub-questions:

(1.1) How far do script and content scheme affect transactivity in argumentation?
(1.2) How far do script and content scheme affect justifications of single arguments?

(2) How far do script and content scheme affect argumentation in task solution? There are two ways of measuring the influence of instructional support methods on argumentative task solution: task solutions worked out collaboratively and individually. Therefore, we need two separate questions:

(2.1) How far do script and content scheme affect argumentation in the task solution worked out collaboratively?
(2.2) How far do script and content scheme affect argumentation in the task solution worked out individually?

Method

Sample and design

One hundred and fifty-six undergraduates of the University of Munich took part in this experiment. Most of the undergraduates were in the second semester. 52 triads were randomly assigned to one of four conditions in a 2x2-factorial design. We varied the factors script (with/without) and content scheme (with/without). Therefore, there were four different conditions: condition with script (13 triads), condition with content scheme (13 triads), combination condition with script and content scheme (14 triads), and control condition (12 triads).

Learning task

Learners had to familiarize themselves with Attribution Theory in an individual learning unit. In a collaborative learning unit three participants had to solve a task together, which described the decrease in a student's performance. Learners received general information that included the cover story and the plot. Furthermore, they got specific information that focused on three perspectives relevant for solving the task – one divergent perspective for every learner. This included the perspective of the student, of the student's mother and the student's teacher. With the help of this specific information they were asked to find explanations and reasons for the student's decrease of performance by applying Attribution Theory. Therefore, two kinds of explanations are relevant: on the one hand, learners had to justify their task solution with theoretical classifications according to Attribution Theory and on the other hand with relevant information of the case. To evoke argumentation, some information in the three perspectives was oppositional.

Learning environment

The whole learning unit was subdivided into an individual and a collaborative learning unit. In the individual learning unit, learners had to read the text about Attribution Theory in order to solve the task together and in order to create a collaborative case solution in the form of a text document. In the collaborative learning unit, learners were connected via a desktop videoconferencing system with audio- and video-connection and a shared application to support the triads' task solution. The shared application functioned as external representation of the joint solution.

Treatments

Both treatments provided a pre-structure of relevant task aspects concerning collaborative task solving and content-specific strategies.

Script. The script structured the collaborative task solving unit into four phases alternating individual and collaborative phases. Each phase consisted of special activities, which the learners had to follow for their collaborative task solving (see figure 1). The first, individual phase consisted of text reading and excerption of the relevant case information. In this first phase, the learners had to consider the main causes mentioned in the specific perspective they worked on and had to write them down. In the second, collaborative phase, learners had to exchange their different information concerning the case. As the information of the perspectives differed in certain ways, it was necessary to discuss the varying causes and possible solutions argumentatively. All issues which were relevant for the solution of the case were to be transferred into the document template. After mentioning and noting all main issues, the learners had to reflect on the appropriateness of the jointly developed notes in the third phase. In the last, fourth phase learners had time to discuss special issues they reflected on in the third phase and had to work out a final version of the task solution.

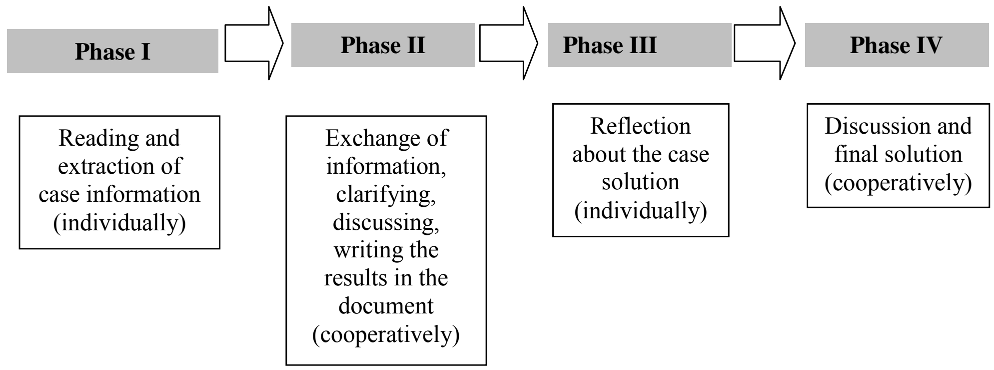

Figure 1: Script

Content scheme. In the condition with content scheme, learners received a content-specific structure of the relevant components concerning Attribution Theory (see table 1). This structure includes cause, information and attribution. Depending on divergent case information, different causes had to be mentioned. To confirm the causes, further information about consensus and consistency was necessary. According to Attribution Theory, consensus and consistency must be classified as high or low and explained with case information. The last category includes attribution according to Kelley (1973) and Heider (1958).

Table 1: Structure of the content scheme with an example

Cause	Information about		Attributions according to	
	Consensus	Consistency	Kelley	Heider
Laziness	Low because he is the only one in class who is lazy	High because he has been lazy for a year now	Person	Internal, variable

Data sources

Argumentation. To investigate argumentation, the discourse was analyzed according to transactive actions and reactions in argumentation and according to the justifications of arguments. In respect to this, a categorization scheme was developed that classified every single turn of the learners' discussion. Ten per cent of these discourses were rated independently by two evaluators.

Transactivity comprised four categories: statement, confirmation, counterargument, and reply. A statement was rated when a learner expressed his point of view on possible causes for the decrease in performance. A statement always included new information and was never related to previous propositions. Confirmation, counterargument and reply were transactive reactions. They could either be related to statements or to another transactive reaction. Did a learner agree with a point of view of his collaborating partner, he confirmed this statement. If there was no agreement, but an opposing statement, it was rated as counterargument. All other transactive reactions like evaluations, integrations or conclusions were in a first step coded separately and in a second step put together as reply. The inter-rater reliability was Kappa .83.

The justifications of arguments were rated according to two categories: with and without justification (Astleitner, 2003). Statements with justification were full arguments with premises and conclusions (e.g. "I think because consensus and consistency is high, it must be an attribution on the object."), statements without justification were assumptions, claims or hypotheses (e.g. “This is an attribution on the person.”). The inter-rater reliability for this categorization was Kappa .90.

Task solution. To measure whether the intervention influenced justifications in the task solution, two different case solutions were analyzed: a case solution worked out collaboratively and individually. These cases were rated according to reasoning processes which were manifested in justifications. Thus, all justifications in case solution were rated. These justifications comprised theory and evidence which are necessary for solving scientific tasks (Kuhn, et al., 1992), respectively theoretical classifications and case information. For ensuring inter-rater reliability of data, two evaluators analyzed 10 per cent of case solutions independently according to the rating scheme. For the collaborative case the Kappa was .86 and for the individual case the Kappa was .92, which were both sufficient. Due to technical problems, two collaborative case solutions get lost. Therefore, only 50 case solutions instead of 52 entered the analyses.

Statistical analyses. In the statistical analyses, we used as a unit of analyses the triad for our collaborative measurements like argumentation and collaborative task solution and the individuals for the individual task solution. We used multivariate ANOVAs with two between-subject factors to analyze the effects of both interventions as well as their interaction on the dependent variables argumentation, collaborative and individual task solution. The statistical tests underlie an alpha level of .05. The discourse examples of argumentation were investigated and analyzed according to transactive reactions and justifications. Although the total time for collaboration was kept constant, the four conditions differed in their collaborative time on task. Scripts reduced the time learners had to collaborate with each other by 10 minutes ($F(1,48)=195.7$; $p<.01$; $\eta^2=.80$). Therefore, we used time as covariate in our data analyses concerning argumentation.

Results

Research question 1: Effects of script and content scheme on argumentation

Taking a closer look at *transactive reactions*, the descriptive statistics shows most utterances concerning the categories statements, counter-arguments and replies in the condition with content scheme (see table 2). Regarding the effects of script and content scheme on transactive reactions, there was one effect of content scheme on statements: Learners with content scheme uttered 25 per cent more statements than learners without content scheme ($F(1,47)=5.83$; $p<.05$; $\eta^2=.11$). There were no further effects and there was no interaction either, even when subdividing the category reply in its subcategories evaluation, integration, and conclusion.

Table 2: Means and SD’s of transactive reactions in the learning discourse

	Statements		Confirmations		Counter-argument		Replies	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Control	58.78	28.06	41.94	27.05	14.77	14.73	64.59	28.22
With script	67.53	26.62	25.89	11.43	14.84	9.87	55.87	17.66
With scheme	81.27	29.73	38.74	20.72	15.61	8.64	64.16	17.14
With script and scheme	82.46	27.00	40.06	10.36	20.55	10.46	67.41	14.81

The *justifications of arguments* should be influenced by content scheme (see table 3). Learners with content scheme used both categories – utterances with justification ($F(1,45)=4.03$; $p<.05$; $\eta^2=.08$) and without justification ($F(1,47)=4.27$; $p<.05$; $\eta^2=.08$) – more often than learners without content scheme. Both effects reached the level of significance.

Table 3: Mean and standard deviation of justifications in the learning discourse

	Justifications			
	without		with	
	M	*SD*	*M*	*SD*
Control	53.47	33.04	20.08	12.74
With script	65.45	31.03	16.93	9.89
With scheme	72.06	28.95	24.82	7.97
With script and scheme	81.28	27.46	21.73	9.71

Research question 2: Effects of script and content scheme on argumentation in task solution

The second question asks, whether script and content scheme had an influence on the justifications of the learners' task solutions, collaboratively and individually. Regarding collaborative task solutions analysed on a group level, learners in the condition with script and content scheme justified their task solution most often with relevant case information (see table 4). The highest score of the combination group with script and content scheme was confirmed by an ANOVA. There was a middle-sized effect of the script ($F(1,46)=4.90$; $p<.05$; $\eta^2=.10$) and a main effect of the content scheme ($F(1,46) = 51.14$; $p < .01$; $\eta^2 = .53$), but no interaction. Justifications with theoretical classifications were fostered by content scheme: Learners with content scheme justified their task solution almost twice as often with theoretical classifications than learners without content scheme. This was a main effect ($F(1,46)=51.52$; $p<.01$; $\eta^2=.53$).

Table 4: Mean and standard deviation of justifications in the collaborative task solution

	Justification with theoretical classifications		Justification with case information	
	M (max. 20)	*SD*	*M* (max. 15)	*SD*
Control group	9.82	4.69	4.82	1.54
With script	7.38	4.23	5.69	2.50
With scheme	16.77	3.32	9.15	3.13
With script and scheme	16.69	3.73	11.38	2.33

Examining individual task solutions, we found almost the same results (see table 5). Thus, learners with script and content scheme showed the highest score in justifying their task solution by giving adequate information. Both interventions had a beneficial effect on the justification with task information in the individual task solution. This showed a multivariate ANCOVA with prior knowledge (justification with case information and theoretical classifications) as covariate. Script ($F(1,150)=7.98$; $p<.01$; $\eta^2=.05$) and content scheme ($F(1,150)=17.75$; $p<.01$; $\eta^2=.11$) had both small effects. In respect of justifications with theoretical classifications, learners with content scheme justified their task solution twice as often with adequate theoretical classifications than learners without content scheme ($F(1,150)=38.78$; $p<.01$; $\eta^2=.21$).

Table 5: Mean and standard deviation of justifications in the individual task solution

	Justification with theoretical classifications		Justification with case information	
	M (max. 8)	*SD*	*M* (max. 6)	*SD*
Control group	2.67	2.04	1.86	1.51
With script	2.54	1.90	2.18	1.57
With scheme	4.60	2.79	2.55	1.80
With script and scheme	5.33	2.72	3.87	1.91

Summary and Discussion

Results of the study showed some effects of the intervention on argumentation as well as on task solution. Regarding argumentation, we analyzed transactivity as well as justifications in argumentation. Transactive reactions, especially stating opinions, were mainly fostered by content scheme. In combination with script, the amount of statements, counter-arguments and replies could be improved on a descriptive level of analyses. Justifying argumentation was fostered by content scheme. In respect to task solution, both script and content scheme had a positive influence: Script improved justifications with case information, content scheme justifications both with case information and with theoretical classifications.

By structuring the collaboration into four phases and providing joint sub-tasks for collaborative task solution, the *script* supported learners in justifying their task solution, the collaborative as well as the individual task solution. In previous studies, the script showed positive effects only on the learning discourse (Ertl, Reiserer, & Mandl, 2002; Härder, 2004; Weinberger, 2003). On the individual task solution, however, the script did not have any positive effects (Ertl, Reiserer, & Mandl, 2002; Reiserer, Ertl, & Mandl, 2002). The collaborative task strategy of focusing on the exchange and the discussion of relevant information proved sufficient for the learners considering relevant information in task solution. This manifested itself in the learners justifying their task solution with adequate case information. Both the collaborative and individual task solving strategy was supported by script. In contrast to previous studies, learners internalized the task strategy of the script, so that they could apply it to their own individual task solution (King, 2007). But the strategy had no effect on transactive reactions in the learning discourse as was hypothesized due to the sub-tasks of the script which were only illustrated in the discourse examples. To sum it up, the collaboration strategy provided by script manifested itself in collaborative and individual task solution by justifications with relevant case information. It did not manifest itself, though, in transactivity. This last result can be due to the fact that the script did not force learners to react transactively to each other according to a strictly limited structure of argumentative collaboration. Further on, the script probably reduced the need for transactive reactions, because individuals were better prepared for collaboration due to the individual reflection phase. But in combination with a content-specific strategy both intervention methods can improve transactivity in the learning discourse.

The *content scheme* made the most important aspects of the content salient. Due to the representational guidance of this table (Suthers, 2003; Suthers, & Hundhausen, 2003), learners got focused on the empty spaces they had to fill in with task relevant aspects. Thus, the content scheme affected argumentative discourse as well as task solutions. Concerning argumentation, the content scheme supported transactivity and justification in argumentation. As important aspects of the task were permanently represented, learners got focused on their own perspective so that they uttered more statements. Concerning the higher degree of counter-arguments and replies on a descriptive level, eventually the same mode of action of the content scheme could be assumed for this result, even though there was no significant effect. As learners knew which aspects they should focus on, they evaluated arguments more adequately. This in itself lead to more counter-arguments as discrepancies were discovered and to more replies resulting from evaluating or concluding. Moreover, for solving the task adequately it was necessary to justify every theoretical classification and case information that would be filled in the empty spaces of the content scheme. This implicit demand manifested itself in the argumentation discourse as more arguments with justifications were constructed. These results are in line with other studies using content scheme as support method (Fischer, Bruhn, Gräsel, & Mandl, 2000; Suthers, & Hundhausen, 2003). In these studies, learners with content scheme were able to relate hypothesis to evidence, that is in our study theoretical classifications to case information. In addition, content scheme fostered not only argumentative discourse, but also justifications in collaborative and individual task solutions. So far, the content scheme had mostly positive effects on the collaborative task solution (Baker, & Lund, 1997; Kanselaar, et al., 2003; Suthers, 2003), but not on the individual task solution. Possibly, the previous content schemes were too unspecific (De Jong, et al, 1998), so that learners could not acquire the content as well as an implicit task solving strategy. This was possible in the study at hand. Thus, learners were able to justify their task solution collaboratively and individually both with adequate theoretical classifications and with case information.

Conclusion

Concluding, both interventions had a positive influence on argumentation which was reflected in the learning discourse and in the collaborative as well as the individual task solution. The script offered a collaborative task strategy that fostered the argumentative exchange of information, while the content scheme made important components of the task solution salient which particularly supported activities of justification. Looking at the application scenario, we can see that indirect support methods directly implemented in the learning environment can affect scientific argumentation activities positively by providing both a collaborative and content-specific task solving strategy. Since argumentation is a very important ability in science, it would be interesting to find out, whether these effects could be replicated in other domains and settings.

In contrast to previous studies both support methods had an effect not only on argumentative collaboration and task solution, but also on the individual task solution. This means that learners were able to acquire not only the content, but also strategies for the application of their argumentative knowledge for task solutions. This effect can be due to the specificity of the instructional support (De Jong, et al., 1998). To sustain this assumption, further analyses concerning this aspect would be helpful.

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