Towards Tool Support for Team Awareness in Collaborative Argumentation

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Abstract: Supporting collaborative argumentation in higher education is a challenging task, and raising the awareness of students on the relational space of their collaboration may be the key to simplifying it. In this paper, we explore the role of team awareness for enhancing the quality of collaborative argumentation. Ten groups of master students from Media Informatics (n= 28) participated in a multiple-case study for arguing on ill-structured problems where they received different team awareness prompts embedded in collaboration scripts , argued for solving the problems and built argument maps. The initial analysis of the argument maps indicates that the social awareness script has a moderately higher impact on the quality of argumentation compared to the behavioural awareness script.

1   INTRODUCTION

Collaborative argumentation is regarded as a highly effective instructional strategy for higher education but it is also linked to big challenges for students who need to take care of the collaboration dynamics in the group while struggling with learning how to argue and arguing for learning at the same time (von Aufschnaiter et al., 2008). Collaboration scripts can facilitate the argumentation processes (Stegmann et al., 2007). When combined with task awareness support (i.e. information on group members' prior and current knowledge) scripts can help students acquire deeper understanding of domain concepts (Gijlers et al., 2013). A recent stream of studies has focused on the facilitation of group awareness and argumentation scripts with tools in online learning situations (Tsovaltzi et al., 2014). However, little is known as to how we can raise team awareness in collocated collaboration through pedagogical scripts and combine them with tools for enhancing argumentation in classroom.

In a first -small scale- study we investigate how different team awareness prompts influence the quality of collaborative argumentation when embedded in a collaborative argumentation script. To meet this need we created two variations of the same pedagogical face-to-face macro-script combining argument scaffold elements with different team awareness prompts. The first script variation included behavioural awareness prompts for informing students about their activities in the group (i.e. reminders for performing participation check, performance comparisons and coordination checks) (Janssen et al., 2011). The second one included social awareness prompts for informing students about the functioning of the group as perceived by their collaborators (i.e. reminders for assigning roles, keeping an open mind and being friendly in the group, openly evaluating their performance) (Phielix et al., 2011). In comparing the different awareness oriented argumentation script variations over four sessions of 75 minutes each for collaborative argumentation we want to shed light on the effects of different team awareness prompts for enhancing (a) team awareness processes and (b) quality of collaborative argumentation and (c) the relation between different team awareness processes and the quality of collaborative argumentation.

At first, we present the background theories for the design of the script variations and their link to tools for collaborative argumentation. We then continue with the multiple case study design and the analysis of the argumentation maps and of the post-study feedback survey. We conclude with a discussion on the initial findings of the first study and their connection to the upcoming study on a tool for facilitating collaborative argumentation with a focus

on enhancing awareness of collaboration (under implementation).

2 BACKGROUND

In order to ground this research within the wider context of technology-enhanced argumentation, we present in this section some interesting research findings on supporting (a) team awareness and (b) scientific reasoning and argumentation which were taken into account for designing the awareness oriented argumentation scripts. Lastly, we explain the rationale behind combing scripts with an argument mapping tool for ensuring equal support for building arguments to all participants in the study.

2.1 Team Awareness Prompts

Beers et al., (2007) indicated that supporting awareness of students' activities in the relational space of collaboration results in improvement in the quality of collaborative processes (e.g. communication of concepts) in the content space of collaboration. Team awareness relates to awareness of expected behaviors in the group- behavioral awareness (Janssen et al., 2011), and to awareness of students functioning in the group as perceived by their collaborators in the relational space of collaboration– social awareness (Phielix et al., 2011). On the other hand, task awareness relates to cognitive information about the knowledge of group members on the content space of collaboration (Janssen et al., 2011).

The effects of scripting collaboration and task raising awareness in collaborative learning settings have been investigated by Gijlers et al., in 2013. They experimented with elementary students and provided them with awareness support and scripting separately. Afterwards, they compared the students in both conditions with respect to their ability to facilitate knowledge construction and discourse quality in a computer supported collaborative drawing scenario. Both forms of collaboration support -awareness and scripting managed to facilitate students' learning processes and outcomes.

In this study, we seek to expand the research on team awareness prompts for collaboration. In our study, students communicate face to face and the prompts in the script encourage a desired mode of communication.

The team awareness prompts are combined here with thought provoking questions and friendly reminders. Prompts are meant to trigger the discussion on the group around not only the information about the individual learner's context, but also on the context of the whole learning team thus supporting the members' fruitful interaction in the group on the relational level of collaboration. By embedding two different sets of awareness prompts (behavioural versus social) in the same basic script for collaborative argumentation and comparing them in the two conditions we want to shed light on the role of different team awareness prompts in enhancing collaborative argumentation.

2.2 Scaffold for Argument Building

Most argumentation scripts rely on Toulmin's model (Toulmin, 2003) for argumentation, where the emphasis is on the identification of structural elements of single arguments (e.g. claims, rebuttals and backing, etc.). The Toulmin model was used here as a basis for designing the argument scaffold for both variations of awareness oriented scripts. Students were also familiarized with the basics of the Toulmin model during a training session prior to our study. Toulmin's logic provides a useful framework with which a student can construct and deconstruct an argument.

Taking a step further from the Toulmin's model for practical reasoning to the direction of promoting high-quality forms of argumentation we built on the eight epistemic activities of scientific reasoning and scientific argumentation in higher education (SRA) as defined by Fischer et al., in 2014 for designing the awareness oriented argumentation scripts. These epistemic activities include; „problem identification, questioning, hypothesis generation, construction and redesign of artefacts, evidence generation, evidence evaluation, drawing conclusions as well as communicating and scrutinizing scientific reasoning and its results"(Fischer et al., p. 29). Regarding this study we focused on enhancing specific SRA skills for constructing artefacts, drawing conclusions and communicating reasoning. We support students in constructing artefacts and drawing conclusions with the concise and intriguing problem cases and with the argument scaffold in the scripts. For facilitating the communication of reasoning processes, we employ argument mapping techniques and a software tool in conjunction with the scripts.

2.3 Argument Mapping and Scripts

Argument maps (also known as argument diagrams) refer to external knowledge representations that can help students to structure visually their arguments

(Scheuer et al., 2013). They allow for increased clarity and reflection on the strength of one's argument by identifying the key components of an essay or a report. They also contribute towards making a convincing argument and can be an effective way to improve general critical thinking skills. Argument maps can be drawn either on paper or in sophisticated technological environments and have some basic theory and visual conventions for constructing and modifying a map as well as for communicating its contents efficiently (i.e. arrows between claims and warrants) (van Gelder, 2013).

Computer-based argument mapping is a rapidly progressing field in computer supported learning research has been found to enhance student critical thinking (Twardy, 2004). Scheuer et al., (2013) have successfully tested the combination of argument diagramming and scripted interfaces for having synergistic effects in promoting high-quality argumentation. They compared students in an argument mapping environment with versus without a script. They found out that scripting could additionally enhance argumentative quality of the discussions.

Taking on their approach, we provide structuring on the epistemic level via the argument scaffolds in the scripts and the web based argument mapping tool Rationale® and combine it with different awareness prompts for supporting forms of social interaction on the relational level of collaboration. The Rationale ® argument mapping tool allows for visualizing and organizing arguments and supporting or objecting them with logic and evidence. The use of this specific system for argument mapping is supported by literature on computer-supported argument visualization (Davies, 2009). Moreover, it is in line with the purpose of this small-scale study for creating awareness oriented argumentation scripts to be tested on software tools for collaborative argumentation.

3 METHODS

This study employs a multiple case study design (Yin, 2009), in which each of the ten groups of Media Informatics master students (n = 28, in ten groups of three or two) is conceptualized as a 'case'. In a separate meeting prior to the study students were trained in the use to the argument mapping tool Rationale® and practiced arguing for solving ill-structured problems based on the Toulmin model and the conventions of the argument mapping tool. Students' main task was to argue for and agree on the best solution to the problem and then transfer their

arguments into a joint argument map using the online argumentation mapping tool Rationale® while collaborating (see Figure 1).
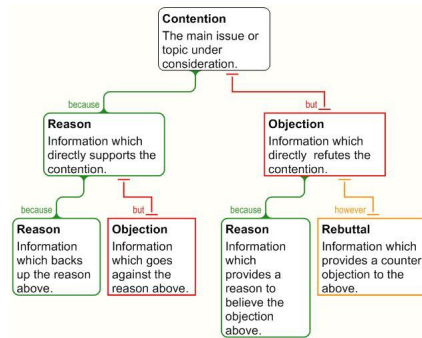

Figure 1: Example argument map in Rationale®.

At the beginning of each session, students were provided with the problem case, the task description and the theory at hand. The problem cases were built to match the contents of a masters' class on "Multimedia-Based Learning Environments" and dealt with topics such as constructivist theory and cognitive load of animations (see Figure 2).

Figure 2: Problem case script card on "animations and cognitive load".

Following, students received help for building their arguments on the map. The argumentation part of the scripts was divided in two subtasks and was presented in two cards with thought provoking questions for triggering the argumentative collaboration on them. The cards were also enhanced with additional argument building help in the form of sentence openers. Furthermore, counter argument support and support for creating backup of claims and bringing examples was included in the cards (see Table 1). Students had twenty minutes for working uninterrupted on each subtask from the argumentation script cards.

Table 1: A script card with argument scaffold for both conditions.

Questions:	In the context of understanding „centrifugal force „would you argue that the animation or the static picture is better in reducing cognitive load?
Sentence openers:	One argument against could be: because: for example:
Prompts:	Please justify your approach by means of examples and back it up with the theory at hand.

Either before or after the students had worked on the argumentative subtasks, they received cards with social or behavioural awareness prompts on paper depending on their condition and they had to discuss them in the group for five minutes (see Table 2). Half of the groups argued on ill-structured problems following the behavioural awareness scripts (behavioural awareness script condition) and the other half following a social awareness script (social awareness script condition). The awareness script cards included one or two questions for the whole group and a prompt for discussing them. Some prompts included also suggestions for coordinating the group work and friendly reminders for the value of the prompts. The script cards in the Behavioural Awareness Script condition prompted students to perform participation checks and coordination checks throughout the collaboration, and evaluate the participation and coordination efforts at the end of every session. Whereas, the script cards in Social Awareness Script condition prompted students to assign roles at the beginning of every session, keep an

Table 2: Examples of cards with team awareness prompts from both conditions.

Social awareness prompt card for evaluating performance.	Behavioural awareness prompt card for coordination check.
How would you evaluate your performance as writer, reviser or controller? Discuss this in the group. Reassign the roles amongst you if needed.	Is the problem case clear to all of you? Discuss any ambiguities in the group. Create a plan for the next steps for solving the problem. Remember: Achieving a common understanding and following your plan will benefit your collaboration.

open mind and be friendly throughout the collaboration, and finally evaluate each other for the performance of the roles.

The video recordings from the collaborative argumentation sessions, as well as the argument maps, produced throughout each session are being analysed using qualitative methods. Finally, students' feedback on their experience with the argumentation and awareness script parts as well as with Rationale® as collected in post-study survey is analysed qualitatively.

3.1 Preliminary Analysis of Results

For deciding on the level of collaborative argumentation (low, medium or high,) we coded the argument maps (element-wise) with respect to criteria of formal correctness and evidence sufficiency (see Table 3). The argument maps were examined against model solutions for each of the ill-structured problems and with respect to the conventions of the argument mapping tool. The coding schemas included the categories of formal completeness (i.e. one reason with two co-premises, full declarative sentences) and evidence sufficiency (i.e. correct and relevant evidence from text, from personal experience or other scientific sources) of arguments. In the initial analysis argument maps from the first session were compared to the ones from the fourth session (20 maps from 10 groups) and examined for any changes in *the quality of collaborative argumentation* in the two conditions.

The quality of team awareness processes is currently being examined using content analysis (Krippendorff, 1989). We code for students' references to the prompts and their application (e.g. engagement in mutual performance monitoring) based on video segments from the five minutes before and after introducing each of the team awareness prompts to the groups in both conditions.

Table 3: Changes in the levels of quality of arguments between the first and the fourth session for collaborative argumentation.

	Formal completeness	Evidence Sufficiency
BAS	Medium→High	Low→ High
SAS	Low→High	Low→Medium

Additionally, we have analyzed qualitatively the answers of the students from an obligatory but anonymized post-study feedback survey on their experience with the argument mapping system and

the script. With respect to the most and least helpful awareness prompts in the script of the BAS condition we observed the following patterns in the answers to the open end questions. Students expressed themselves positively about the coordination checks throughout the collaboration. Creating and following a plan for the collaboration made them *"think about why we weren't as successful as we wished and "forced" us to think about how to change it."* The prompts for running a participation check in the group received mixed comments. One student stated: *"we did not discuss it much in the group, but it helped me personally to reflect whether I am rather quiet today"*. Lastly, the prompts for evaluating the participation and coordination efforts at the end of every session were not perceived well by the BAS students. e.g. *"It feels wrong to compare yourself to your teammates while they sit around you"*.

Students in the SAS condition gave their own feedback on the most and least useful awareness prompts of their script. They commented positively on the prompt for assigning roles and agreed that *"it gave the collaboration a good structure and everyone knew what to do or what tasks to push"*. However, they did not refer positively to the prompt for discussing and evaluating their performance as writers, revisers or controllers in the group e.g. *"reassigning the roles amongst you, if needed - because the all participants contributed in the same way to all of the roles."* Furthermore, students often stated in their answers that the prompts for keeping an open mind and being friendly throughout the collaboration helped them *"get different minds together"*.

Regarding the timing of the appearance of the prompts, students in both conditions referred to it as *"rather disruptive"* for the collaboration. The time assigned for working on the prompts (5 minutes for each prompt) was found to be *"more than enough"* in most cases. Most of students' statements about the time assigned for working on the argumentation tasks were in line with this one: *"20 minutes is enough to sketch out some pros and cons for the argument"*. The students in both conditions were also asked about the use of the additional argument scaffold provided by the script. Most students agreed that sentence openers and the thought provoking questions were helpful to them but not the counter argument support or the support for creating backup of claims and bringing examples.

Finally, most students in both conditions reported positive tendencies for future use of the Rationale® system. However, many of them criticized the system for the fact that *"only one person can work with the mapping tool at a same time. "*

4 FINDINGS

The initial analysis of argument maps from the first and the fourth session for collaboration between the two conditions showed that groups in both conditions increased the levels of formal completeness and evidence sufficiency of their arguments between the sessions. A closer look to formal completeness levels of arguments indicates that the *social awareness script* condition (*SAS*) did moderately better in raising their FC levels from low or medium to high than the groups in the *behavioural awareness script condition* (*BAS*). However, the patterns change slightly in favour of the groups in the BAS condition in the case of evidence sufficiency levels of arguments when comparing the two conditions with respect to their ES levels in the first and the fourth session. When accounting for both the levels of formal completeness and evidence sufficiency as an indicator of the quality of collaborative argumentation, we observe that SAS condition did better in all groups.

The analysis of the post-study feedback survey showed that students in the BAS condition liked particularly the prompts for achieving a common understanding prior to arguing. However, they reported feelings of uneasiness when it came to evaluating the participation and coordination efforts at the end of every session. In the SAS condition, students found the prompt for assigning roles in the group of practical use for organizing the group workflow but they did not like evaluating their performance openly in the group. Students' opinions on the timings of the script were rather positive. The argument scaffold was only partially used (i.e. thought provoking questions). Finally, students acknowledged the benefits of working with an argument mapping tool but pointed out the technical difficulties of working with Rationale® on one computer in group. Currently, we are working on the content analysis for the *quality of team awareness processes* from the videos.

5 CONCLUSIONS

The moderate improvement in the quality of collaborative argumentation in the *social awareness script* condition indicates that information about the functioning of the group as perceived by their collaborators could be more helpful for enhancing

collocated collaborative argumentation in higher education than information about activities in the group. A further analysis of the argument maps from all sessions across conditions may be needed for explaining the low levels of evidence sufficiency and highlight the sophistication of students' arguments over time. In this respect, the ongoing content analysis of the group discussions on the different team awareness prompts might shed light on the *relation between the team awareness processes* and the *quality of collaborative argumentation*. The direct feedback of students on the experience with of the awareness and argumentation script parts in both conditions will complement the main analysis.

Our expectation from this small scale qualitative study is to gain useful insights on the importance of different kinds of team awareness for improving the quality of arguments. These insights will be used for creating a balanced awareness oriented CSCL script for a collaborative argumentation tool (currently under implementation) in a follow up intervention study. The goal of this study is to identify how information about social and behavioral issues of collaboration can be effectively transformed to features of a system for collaborative argumentation mapping (Rationale®). The system will run on interactive tablet displays and browser technologies and will aim at facilitating collocated collaborative argumentation with argument mapping in higher education settings.

REFERENCES

Davies, W. M. (2009). Computer-assisted argument mapping: a rationale approach. *Higher Education*, *58*(6), 799-820.

Fischer, F., Kollar, I., Ufer, S., Sodian, B., Hussmann, H., Pekrun, R., ... & Strijbos, J. W. (2014). Scientific reasoning and argumentation: Advancing an interdisciplinary research agenda in education. *Frontline Learning Research, 2*(3), 28-45.

Gijlers, H., Weinberger, A., van Dijk, A. M., Bollen, L., & van Joolingen, W. (2013). Collaborative drawing on a shared digital canvas in elementary science education: The effects of script and task awareness support. *International journal of computer-supported collaborative learning, 8*(4), 427-453.

Janssen, J., Erkens, G., & Kirschner, P. A. (2011). Group awareness tools: It's what you do with it that matters. *Computers in Human Behavior, 27*(3), 1046-1058.

Krippendorff, K. (1989). Content analysis. In E. Barnouw, G. Gerbner, W. Schramm, T. L. Worth, & L. Gross (Eds.), *International encyclopedia of communication* (Vol. 1, pp. 403-407). New York, NY: Oxford

University Press. Retrieved from http://repository.upen n.edu/asc_papers/226.

Phielix, C., Prins, F. J., Kirschner, P. A., Erkens, G., & Jaspers, J. (2011). Group awareness of social and cognitive performance in a CSCL environment: Effects of a peer feedback and reflection tool. *Computers in Human Behavior, 27*, 1087–1102.

Scheuer, O., McLaren, B. M., Weinberger, A., & Niebuhr, S. (2014). Promoting critical, elaborative discussions through a collaboration script and argument diagrams. *Instructional Science, 42*(2), 127-157.

Stegmann, K., Weinberger, A., & Fischer, F. (2007). Facilitating argumentative knowledge construction with computer-supported collaboration scripts. *International journal of computer-supported collaborative learning, 2*(4), 421-447.

Toulmin, S. (2003). *The uses of argument.* Cambridge University Press.

Tsovaltzi, D., Puhl, T., Judele, R., & Weinberger, A. (2014). Group awareness support and argumentation scripts for individual preparation of arguments in Facebook. *Computers & Education, 76*, 108-118.

Twardy, C. (2004). Argument maps improve critical thinking. *Teaching Philosophy, 27*(2), 95-116.

van Gelder, T. (2013) Argument mapping. In Pashler, H. (ed.), *Encyclopedia of the Mind*. Thousand Oaks, CA: Sage.

Von Aufschnaiter, C., Erduran, S., Osborne, J., & Simon, S. (2008). Arguing to learn and learning to argue: Case studies of how students' argumentation relates to their scientific knowledge. *Journal of Research in Science Teaching, 45*(1), 101-131.

Yin, R. K. (2013). *Case study research: Design and methods*. Sage publications.