SUPPORTING COMPUTER-SUPPORTED ARGUMENTATIVE KNOWLEDGE CONSTRUCTION IN MULTI-DISCIPLINARY GROUPS OF LEARNERS

O. Noroozi[1], H. Biemans[1], A. Weinberger[2], M. Mulder[1], V. Popov[1], M. Chizari[3]

[1] Wageningen University (NETHERLANDS)
[2] Saarland University (GERMANY)
[3] Tarbiat Modares University (ISLAMIC REPUBLIC OF IRAN)
omid.noroozi@wur.nl

Abstract

Learning to argue is an essential objective in education and the ability to argue is a key skill in approaching complex problems as well as in collecting observational data and applying rules of formal logic. External representations such as computer support can foster interaction and discussion of collaborating partners and also argumentation only implicitly. Orchestration of argumentation and discussion in online learning environments in what has been named Computer Supported Collaborative Learning (CSCL) builds on multiple representations and instructional interventions. Argumentative knowledge construction is one of the most prominent scenarios in online collaborative learning environments that have been subjects of interest to many scholars in the domain of education and educational research. In argumentative knowledge construction, learners are supposed to build arguments and support a position, to consider and weigh arguments and counter-arguments, to test, enlighten, and clarify their uncertainties, to elaborate the learning material, and thus acquire knowledge and achieve understanding about complex ill-structured problems. The current empirical study used a set of transactive argumentation script to facilitate both process and outcome categories of argumentative knowledge construction within the context of multi-disciplinary learners in CSCL. The design of this transactive argumentation script builds on and modifies the coding scheme from Berkowitz and Gibbs (1983) that provide an extensive categorization of transactive contributions which have been regarded as important tool for learning. The results showed that the transactive argumentative script in forms of question prompts improve learners' argumentative structure (i.e. formal quality of single arguments and argumentation sequences) during online discussion as well as individual domain-specific knowledge acquisition as the final product.

Keywords: Argumentative knowledge construction; collaborative learning; CSCL; multidisciplinary teams; transactive argumentation script.

1 INTRODUCTION

Learning to argue is an essential objective in education and the ability to argue is a key skill in approaching complex problems as well as in collecting observational data and applying rules of formal logic (Voss & Van Dyke, 2001). Engaging learners in dialogic argumentation in what has been called Collaborative Argumentation-based Learning (CABLE) is an educational approach for preparing learners to manage today's complex issues and actively participates in knowledge societies (Van Amelsvoort et al., 2007). CABLE teaches learners to build arguments and support a position, to consider and weigh arguments and counter-arguments, to test, enlighten, and clarify their uncertainties, and thus achieve understanding about complex ill-structured problems (Aleixandre-Jimenez, 2007; Cho & Jonassen, 2002). Although implementation of CABLE in a variety of educational settings has resulted in positive learning effects (Van Amelsvoort et al., 2007), it has also been said that telling learners to argue with each other is not a sufficient way to attain CABLE's potential (e.g. Baker, 1999; Van Amelsvoort et al. 2007). To support CABLE, argumentation must be framed, scaffolded and guided by external representations (Mirza et al., 2007). In the last 15 years, online support systems for argumentation in which learners argue in teams have been found to support the sharing, constructing and representing of arguments in multiple formats. Orchestration of argumentation in online learning environments builds on multiple representations and instructional interventions. External representations such as computer support can foster interaction and discussion of collaborating partners and also argumentation only implicitly (Van Bruggen, & Kirschner, 2003).

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Argumentative knowledge construction is one of the most prominent scenarios in online collaborative learning environments that have been subjects of interest to many scholars in the domain of education and educational research. In argumentative knowledge construction, learners are supposed to build arguments and support a position, to consider and weigh arguments and counter-arguments, to test, enlighten, and clarify their uncertainties, to elaborate on the learning materials, and thus acquire knowledge and achieve understanding about complex ill-structured problems. An approach in collaborative argumentation classifies argumentative knowledge construction into two process categories, namely micro-level (construction of single argument) and macro-level (construction of sequences of argumentation) in CSCL (Stegmann et al., 2007; Weinberger & Fischer, 2006; Weinberger et al., 2005 & 2007). Furthermore, the prominent approach to argumentative knowledge construction differentiates between two outcome dimensions namely acquisition of domain-specific and domain-general knowledge e.g. knowledge on argumentation, both of which will be discussed in the present study.

Platforms for online learning environments have evolved to increase deep learning and student knowledge construction. They could also encourage students to discuss their ideas, concepts and problems from different perspectives and viewpoints in order to re-construct and co-construct knowledge while solving authentic and complex problems (Noroozi et al., 2009a, 2009b, 2009c, 2009d, 2010a, 2010b, 2011; Veldhuis-Diermanse et al., 2006). Over the last few years, a variety of scaffolding approaches (e.g. awareness features, design-based discussion tools, knowledge representations, scripts, etc.) have been designed and developed in Computer Supported Collaborative Learning (CSCL) to support argumentation. Computer supported collaboration scripts have been seen as one of the most prominent instructional approach to facilitate argumentative knowledge construction in CSCL. Scripts are complex instructions that stipulate the type and sequence of collaborative learning activities in order to help group members collaborate and accomplish tasks. Empirical evidence has shown positive relations between argumentative structure (high quality argumentation) in online discourse and individual knowledge acquisition (see Jermann & Dillenbourg, 2003; Kuhn et al., 1997; Leitão, 2000). As the result, various forms of argumentative collaboration scripts have been designed to facilitate particular discourse activities such as the construction of single arguments by supporting learners to warrant their claims as well as the construction of argumentation sequences by supporting learners in following specific argumentation sequences e.g., argument, counterargument, integration etc. (see Kollar et al., 2007; Stegmann et al., 2007). In spite of positive effects of these scripts on the discourse activities they were directed at and also on the acquisition of knowledge on argumentation (see Jermann & Dillenbourg, 2003; Kollar et al., 2007; Kuhn, 1997; Stegmann et al., 2007), not all of them facilitated the acquisition of domain-specific knowledge (see Kollar et al., 2007; Stegmann et al., 2007; Weinberger et al., 2005 & 2007). The reason that these studies do not always report positive effects of argumentative collaboration scripts on domain-specific knowledge acquisition is that working with argumentative collaboration scripts demands learners to allocate a considerable part of their cognitive capacity to argumentation and hence little cognitive effort and time could be allocated to elaboration of the learning material and additional resources for enhanced domain-specific knowledge acquisition (Stegmann et al., 2007; Weinberger et al., 2005 & 2007). An important question for research in CSCL is how argumentative collaboration scripts can be designed to facilitate argumentative discourse activities in such a way to also promote cognitive elaboration of the learning materials for acquiring domain-specific knowledge and knowledge on argumentation. Facilitating argumentative knowledge construction may, therefore, not only be a question of how to support argumentative discourse activities, but also a question of how to shape argumentative structure for enhanced domain-specific knowledge acquisition.

It seems that alternative instructional information in how to design argumentative collaboration scripts is needed if learners are to construct sound arguments and engage in proper argumentation sequences in such a way to also benefit from argumentative activities as an approach for acquiring domain-specific knowledge and knowledge on argumentation. In our experimental approach, we seek to balance between argumentative discourse activities and cognitive elaboration of the learning materials using a new set of transactive argumentation script. The design of this transactive argumentation script builds on and modifies the coding scheme from Berkowitz and Gibbs (1983) that provide an extensive categorization of transactive contributions which have been regarded as important tool for learning. Transactivity is a term derived from Berkowitz and Gibbs (1983) and introduced to collaborative learning by Teasley (1997) meaning “reasoning operating on the reasoning of the other”. Transactivity indicates to what extent learners build on, relate to, and refer to what their learning partners have said before. Transactivity has been regarded as one of the main “engines of collaborative knowledge construction” and is connected to level of cognitive elaboration and individual knowledge construction i.e. the more learners build on the reasoning of their learning partners, the more they benefit from learning together. Building on the literature on computer supported collaboration scripts, we have modified Berkowitz and Gibbs (1983) scheme in such a way to facilitate argument reception as well as argument construction with the goal to have transactive argumentation. When learners engage in more transactive discussions, they benefit to a greater extent from the external memories available e.g. contributions of their learning partners (e.g. Teasley, 1997; Weinberger et al., 2005 & 2007). Building on the Berkowitz and Gibbs (1983) coding scheme, we designed four types of question prompts (i.e. question prompts for argumentation analysis, feedback analysis, extension of the argument and construction of argumentation sequences) to promote transactive argumentation. In our assumption, both argumentative discourse activities and also domain-specific knowledge acquisition could be facilitated if learners sufficiently elaborate on the learning material in a transactive manner when making analyses of the argument(s) being put forward by their partners and constructing arguments that relate to already externalized arguments.

2 RESEARCH QUESTIONS

To date, research has not focused systematically on supporting transactive argumentation in CSCL with appropriate support measures. It is unclear to what extent argumentative discourse activities (structure of single arguments and argumentation sequences) can be facilitated using transactive argumentation script. Furthermore, there has been little empirical research on the assumption that both construction and reception of sound arguments and exchanging them in an argumentation sequences has a positive effect on domain-specific knowledge acquisition. Therefore, the following research questions were formulated to address these issues:

1. To what extent can a transactive argumentation script (with vs. without) affect argumentative discourse activities (construction of single arguments and argumentation sequences) of multi-disciplinary groups of learners in a problem-based CSCL?
2. To what extent is individual domain-general knowledge acquisition (knowledge on argumentation) affected by a transactive argumentation script in a problem-based CSCL of multi-disciplinary groups of learners?
3. To what extent is individual domain-specific knowledge acquisition affected by a transactive argumentation script in a problem-based CSCL of multi-disciplinary groups of learners?

3 METHOD

3.1 Context and participants

The study took place at Wageningen University in the central Netherlands, whose student body represents over 100 nationalities. Participants were sixty (60) master students with two different disciplinary backgrounds i.e. international land and water management as well as international development studies. These two complementary expertise were required for accomplishing the learning task in this study. The participants were compensated $12 per hour for their contribution in this study. The participants were separated into pairs based on their disciplinary backgrounds, and each pair was randomly assigned to one of the experimental and control conditions in a one-factorial design. Each pair included one learner with water management disciplinary background and one learner with international development disciplinary background. After dividing pairs of learners into two sub-groups, each of which included 15 pairs, one sub-group was given the script for construction of transactive argumentation script and the other sub-group, the control group, was not given a script. The experimental conditions differed only with respect to the components of transactive argumentation script that was implemented in the learning environment using the interface of the computer-supported environment.

The subject of the learning environment was the concept of “Community-Based Social Marketing (CBSM) and its application in Sustainable Agricultural Water Management (SAWM). The task of the participants was to apply the concept of CBSM in fostering sustainable behaviour among farmers in terms of SAWM. More specifically, learners were demanded to analyse the problem case and design an effective plan for fostering sustainable behaviour. They were asked to take into account the various perspectives on the need – or lack thereof – the farmers perceive in implementing SAWN based on

CBSM perspective. The learning task was authentic, complex and allowed learners to construct different arguments based on the concepts of CBSM and SAWM. CBSM is based upon research in the social sciences demonstrating that behaviour change is most effectively achieved through initiatives delivered at the community level which focus on removing barriers to an activity while simultaneously enhancing the activities benefits. Learners with international development background were supposed to have knowledge about the CBSM. They required to have passed at least a course in which the concept of CBSM had been studied. Learners with international land and water management background were supposed to have knowledge on SAWM. They thus required to have passed at least a course in which the concept of SAWM had been studied.

The two learning partners in each group were distributed over two laboratory rooms. An asynchronous text-based discussion board called “SharePoint” was customized for the purpose of our study for collaboration phase. The task for both learners in the control and experimental conditions was to analyse and discuss the problem case in pairs on the basis of the theoretical case (conceptual space) and to arrive at a joint solution for each point they had made individually with the goals to (1) learn to argue in their specific domains in terms of providing sound reasons for their claims, (2) to learn from each other, and (3) to share as much knowledge as possible after the collaboration. The CSCL platform for learners with the transactive argumentation script was the same as in the control group except for the transactive argumentation script. In experimental condition, every group member first was asked to individually analyse the problem case and then to submit that into a blank text box. The learning partners were then asked to discuss the case on the basis of one another individual analyses while receiving additional guidance that applies to every reply they send off. Building on modified coding scheme from Berkowitz and Gibbs (1983), four types of question prompts were automatically embedded into the reply messages in text windows each of which expected to facilitate various process and outcome categories of argumentative knowledge construction. On the basis of four types of question prompts for facilitation of transactive argumentation, each participant was then demanded to paraphrase, criticize, ask clarifying/extension questions, give counter-argument, and propose integration of argument to each message that had been posted by the learning partner until they reach to consensus and indicate agreement on the solutions. Learners could either start a new topic by posting a new message or reply to messages that had been posted previously.

4 PROCEDURE

Overall, the experimental session took nearly about 3,5 hr. consisted of four main phases with a 10 min break between phases two and three. During the (1) introduction and pre-test phase which took 35 min, individual learners received introductory explanations for 5 min. Then, learners were asked to complete several questionnaires (15 min) on demographic variables, collaboration and computer experiences etc. Next, the learners’ knowledge on argumentation tests took place (15 min). These tests measured the learners’ prior knowledge on both formal quality of single arguments and argumentation sequences. The data from these tests were also used to check whether experimental randomization was successful. During the (2) individual learning phase, learners first received introductory explanations on how to analyse the case (5 min). They were then given 5 min to read the problem case and 10 min to study a three page summary of the theoretical text regarding SAWM and CBSM and also demographic characteristics of the farmers and the location of the case study. Learners were allowed to make notes and keep the text and their notes during the experiment. Prior to collaboration, learners were demanded to individually analyse the problem case and design an effective plan (20 min) for fostering sustainable behavior in terms of SAWM as a CBSM advisor. The data from this test served two purposes: It was used to assess domain-specific prior knowledge of learners regarding SAWM and CBSM. This helped us to make sure that there is knowledge heterogeneity among learners with two different disciplinary backgrounds. As an additional data, it was also used to assess learners’ prior knowledge on both formal quality of single arguments and argumentation sequences. After 10 min break, the (3) collaborative learning phase (90 min) took place. First, learners were oriented to the CSCL platform and then they were acquainted with the procedure of the collaboration phase (10 min). Subsequently, learners were asked to discuss, and argue their analyses and design plans in pairs within 80 min. During the (4) post-test and debriefing phase (45 min), learners were first asked to work on an identical case-based assignment individually (20 min) based on what they had learnt in the collaboration phase. More specifically they were demanded to individually analyse and design an effective plan for fostering sustainable behavior among Nahavand wheat farmers in terms of irrigation method as a CBSM advisor. This was served as the criteria for assessing domain-specific knowledge application. As an additional data, it was also used to assess learners’ domain-general knowledge application i.e. knowledge on argumentation.

Furthermore, as a post-test, learners' knowledge on argumentation was measured separately (15 min). Learners were also demanded to fill out a short questionnaire to assess their satisfaction with the learning effects (5 min). Finally, the participants got a short debriefing for about 5 min.

5 MEASUREMENTS, INSTRUMENTS, AND DATA SOURCES

5.1 Discourse Data for Assessing Knowledge on Argumentation

The learners' online contributions during the collaborative learning phase were analysed by means of a coding scheme developed by Weinberger and Fischer (2006). First, trained coders segmented the discourse corpora based on propositional units, i.e. the criterion for segmentation was to separate units that include concepts from SAWM and CBSM that could be evaluated as true or false. With respect to the segmentation of the discourse corpora, the coders achieved an agreement of 85% during the training. The discrepancies were then resolved through discussion. Second, the segmented discussions were analysed for the formal quality of single arguments and argumentation sequences based on Weinberger and Fischer (2006). In all measurements, we calculated both inter-rater agreement and intra-coder test-retest reliability which were sufficient.

Assessing formal quality of single arguments. We used share of segments that were coded as claims with grounds and/or qualifications to measure the formal quality of single arguments in online discussion. Following Weinberger and Fischer (2006), the trained coders distinguished between (1) bare claims, (2) supported claims, (3) limited claims, (4) supported and limited claims, and (5) non-argumentative moves. Two coders coded the online discussions both in the control group and experimental conditions.

Assessing formal quality of argumentation sequences. We used sequence analyses of learners' online discussion to measure the formal quality of argumentation sequences. Following Leitão (2000), the trained coders distinguished between arguments, counterarguments, integrations, and non-argumentative moves (see also Kollar et al., 2007; Leitão, 2000; Stegmann et al 2007; Weinberger & Fisher, 2006; Weinberger et al., 2005 & 2007). We counted the number of transitions from argument to counterargument, counterargument to integration, and integration to counterargument as indicator of quality of argumentation sequences for each dyad.

Measuring Individual Knowledge Acquisition

The learners' individual written analyses (prior to and after collaboration) as well as knowledge tests (pre-test and post-test) were analysed as indicators of outcomes of individual knowledge acquisition. Individual knowledge acquisition was operationalized in terms of acquisition of knowledge on argumentation and domain-specific knowledge.

Measuring individual acquisition of formal quality of single arguments. First, the written analyses of the individual learners prior to and after collaboration were differentiated and segmented in terms of components of single arguments (claim, ground, and qualifier) (see also Kollar et al., 2007; Leitão, 2000; Stegmann et al 2007; Weinberger & Fisher, 2006; Weinberger et al., 2005 & 2007). The formal quality of single arguments was operationalized as the amount of arguments (claims) that were either supported (with grounds) or limited (with qualifications), or both in the individual analyses of each learner both in the pre-test and post-test. We therefore counted the sum of claims that were either supported, limited, or both. The difference in components of single arguments that the individual learners were able to construct before and after collaboration (M=t2-t1) was counted and served as indicator for the individual acquisition of knowledge on formal quality of single arguments.

Measuring individual acquisition of formal quality of argumentation sequences. A pre-test, post-test design was used to measure individual learners' acquisition of knowledge on formal quality of argumentation sequences. Learners were provided with argumentative texts about "private and public education" in the pre-test and "multi-cultural and mono-cultural group work in school" in the post-test in which they were demanded to identify "good' and "poor" argumentative moves (e.g. too short or/and non-sequential or/and non-supported arguments). They were asked to back up their choice with explanations and arguments. The "good" argumentative texts contained all of the components of the Leitão model (argument, counterargument, and integration), whereas the "poor" argumentative texts lacked at least one of those components. For each learner, 3 points were assigned for the correct identification of good and poor argumentative text and 3 points for a reasonable explanation about the choice they had made. As a maximum, both in the pre-test and post-test, 6 points could be reached on these measures by each individual learner. The gain of knowledge from pre-test to post-test (M=t2-t1) was counted and served as indicator for the acquisition of knowledge on formal quality of argumentation sequences.

Measuring individual acquisition of domain-specific knowledge. Individual written analyses prior to and after collaboration were analysed by means of a segmentation (the same segmentation rules as for the discourse data were applied) and coding procedure developed by Weinberger and Fischer (2006). To do so, experts identified all possible propositional units related to applications of theoretical concepts (SAWM and CBSM) to problem case information. The sum of propositional units (relevant and correct relations between theoretical concepts and case information) prior to and after collaboration was used as an indicator for domain-specific prior knowledge and individual acquisition of domain-specific knowledge after collaboration. The difference in number of these propositions that the individual learners were able to construct prior to and after collaboration (M=t2-t1) was counted and served as indicator for the individual acquisition of domain-specific knowledge for each participant.

6 RESULTS

6.1 Results for Research Question 1

In this section we will first present the findings on the quality of single arguments during discourse activities. Then, we will describe the results for the quality of argumentation sequences.

Construction of Single Arguments during Discourse Activities. The results showed that the question prompts for argumentation analysis (making analyses of the partners' arguments) and paraphrasing them into pre-structured boxes i.e. claim, grounds, and qualifications improve formal quality of single arguments during online discussion. In other words, making analyses of the partners' arguments in the experimental condition helped pairs of learners to provide more supported and/or limited claims during online discussion compared to the control group. Furthermore, we analysed the developments of construction of single arguments during collaborative phase in their chronological order. The results showed learners in the experimental condition provide more supported and/or limited claims at the final stage of collaborative phase than in the middle and the beginning of online discussion. In other words, in the experimental condition, making more analyses of the partners' arguments during collaborative phase in a chronological order helped learners to provide more supported and/or limited claims. No significant differences were found in the development of construction of single arguments for learners in the control condition collaborative phase.

Construction of Argumentation Sequences during Discourse Activities. The results showed that the question prompts for construction of argumentation sequences improve formal quality of argumentation sequences during online discussion. In other words, the question prompts for construction of argumentation sequences facilitated the argumentative structure in terms of transitions from argument to counterargument, counterargument to integration, and integration to counterargument as indicator of quality of argumentation sequences for each dyad. Furthermore, we analysed the developments of construction of argumentation sequences during collaborative phase in their chronological order. The results showed learners in the experimental condition provide more counter-arguments at the final stage of collaborative phase than in the middle and the beginning of online discussion. In other words, in the experimental condition, question prompts for construction of argumentation sequences during collaborative phase in a chronological order helped learners to provide more counter-arguments. No significant differences were found in the development of construction of argumentation sequences for learners in the control condition collaborative phase.

6.2 Results for Research Question 2

In this section we will first present the findings on the individual domain-general knowledge acquisition in terms of construction of single arguments. Then, we will describe the results for the individual domain-general knowledge acquisition in terms of construction of argumentation sequences.

Acquisition of Construction of Single Arguments. The results showed that the support from transactive argumentation script facilitate the acquisition of knowledge on argumentation (in terms of construction of single arguments) as the necessary information was accessible in the learning environment through representation of transactive argumentation script. More specifically, the gain of knowledge from pre-test to post-test for learners who were supported with question prompts for construction of single arguments during the learning process was higher than learners in the control group without question prompts for construction of single arguments.

Acquisition of Construction of Argumentation Sequences. The results showed that the support from transactive argumentation script facilitate the acquisition of knowledge on argumentation (in terms of construction of argumentation sequences) as the necessary information was accessible in the learning environment through representation of transactive argumentation script. More specifically, the gain of knowledge from pre-test to post-test for learners who were supported with question prompts for construction of argumentation sequences during the learning process was higher than learners in the control group without question prompts for construction of argumentation sequences.

6.3 Results for Research Question 3

In this section we will present the findings on the individual domain-specific knowledge acquisition. The results showed that the support from transactive argumentation script facilitate the acquisition of domain-specific knowledge as both transactivity and elaboration of the learning material were facilitated through question prompt for feedback analysis (clarification aspects of the case) and extension of the argument (further explanation and development of the arguments). More specifically, in the experimental condition, learners had the opportunity to clarify various perspective of the learning task and further develop and elaborate on that through the representation of transactive argumentative script. Facilitation of clarification and elaboration of the learning materials through transactive argumentative script helped learners in the experimental condition to improve their domain-specific knowledge from pre-test to post-test.

7 SUMMARY AND CONCLUSION

In this study, four types of question prompts (i.e. question prompts for argumentation analysis, feedback analysis, extension of the argument and construction of argumentation sequences) were designed to facilitate transactive argumentation. The assumption was that both argumentative discourse activities and also domain-specific knowledge acquisition would be facilitated if learners sufficiently elaborate on the learning material in a transactive manner when making analyses of the argument(s) being put forward by their partners and constructing arguments that relate to already externalized arguments. The results of the current empirical study confirmed that various forms of transactive argumentative script positively facilitated the specific learning processes and activities they were aimed at. More specifically, the question prompts for argumentation analysis (making analyses of the partners' arguments) and paraphrasing them into pre-structured boxes i.e. claim, grounds, and qualifications improved formal quality of single arguments during online discussion. The question prompts for construction of argumentation sequences facilitated the argumentative structure in terms of transitions from argument to counterargument, counterargument to integration, and integration to counterargument as indicator of quality of argumentation sequences for each dyad. The support from transactive argumentation script facilitated learners' acquisition of knowledge on argumentation (both construction of single arguments and argumentation sequences) as the necessary information was accessible in the learning environment through representation of transactive argumentation script. These results are consistent with findings of the previous studies in which various forms of argumentative scripts positively facilitated the specific activities they were aimed at. For instance, a set of specific argumentative sentence starters facilitated the construction of counter-argument (Nussbaum et al, 2004) and sound arguments (Yiong-Hwee & Churchill) during online discussion. The argumentative scripts (Stegmann et al., 2007) and the ArgueGraph script (Jermann & Dillenbourg, 2003) facilitated argumentative discourse. Epistemic scripts (content-oriented scripts) facilitated the epistemic quality of the discourse (Schellens et al., 2007; Weinberger et al., 2005 & 2007). As a matter of fact, when learners engage in more transactive discussions and argumentations, they benefit to a greater extent from the external memories available e.g. contributions of their learning partners (e.g. Teasley, 1997; Weinberger et al., 2005 & 2007). Argumentative scripts can be used to structure and formulate the construction of broad, deep, and justified arguments in CSCL environments (Noroozi et al., 2011; Weinberger et al., 2005 & 2007). Using specific facilities implemented in the user-interface may encourage the use of grounds (data/warrant/backing), or supporting and elaborating a claim by qualification (qualifier/rebuttal), or constructing a complete argumentation sequence (argument/ counterargument/integration) to indicate the consideration of alternative explanations and extended argumentation solutions, which in turn may help learners to broaden and deepen the space of debate (Stegmann et al., 2007; Weinberger et al., 2007). Empirical studies have shown that argumentative scripts can lead to more elaborated, justified, deeper and broader arguments, which in turn can effectively facilitate the specific discourse processes of knowledge construction when it comes to warranting and qualifying claims (Stegmann et al., 2007; Weinberger et al., 2007).

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