The Use of "Knowledge Types" as Scripting Tool to Enhance Critical Thinking in Online Discussions

Hilde Van Keer, Tammy Schellens, Bram De Wever, and Martin Valcke,
Department of Education, Ghent University, H. Dunantlaan 2, 9000 Gent, Belgium
[Hilde.VanKeer] [Tammy.Schellens] [Bram.DeWever] [Martin.Valcke] @UGent.be

Abstract: The present study focuses on a particular scripting tool, namely the use of "knowledge types" as a way to structure university students' discourse in asynchronous discussion groups and consequently promote their learning. More specifically, the aim of the study is to determine how requiring students to label their contributions by means of the stages of the progressive inquiry model affects the ongoing critical thinking processes reflected in the discussion.
Preliminary results indicate that using this scripting tool can –under certain circumstances- enhance critical thinking in online discussions.

Objective

The present study focuses on the use of scripts to scaffold students' online discourse and to facilitate their critical thinking. The concept "script", however, encompasses a broad range of methods, techniques, and approaches. In this respect it is difficult to speak about the overall efficacy of CSCL scripts (Dillenbourg, 2002). In the present study, we are interested in the impact of a particular kind of scripting **-** the use of *knowledge types* - on the knowledge construction processes reflected in asynchronous discussions. As part of the course "Instructional Sciences", 287 first-year university students were engaged in asynchronous discussion groups. Two research conditions were distinguished. In the experimental condition, students were required to tag their contributions by means of knowledge types. In the control condition students were engaged in an identical assignment. However, no requirements were made with regard to labeling the knowledge type reflected in one's contributions. In both research conditions cross-ages peer tutors were following the discussion.
The study is guided by the following research questions: 1) Do students, who were required to tag their discussion contributions by means of knowledge types, differ from students engaged in regular asynchronous discussions with regard to (a) the overall depth of critical thinking, (b) the depth of critical thinking for different categories and indicators, and (c) the depth of critical thinking at successive critical thinking stages distinguished by Garrison.
2) What is the impact of differential tutor behavior?

Theoretical Framework

Critical Thinking

The present study focuses on the possible impact of collaborative learning on critical thinking, which is often cited as aim or outcome of education (Perkins & Murphy, 2006). The evolution towards an information age has focused attention on good thinking as an important element of life success. These changing conditions require new outcomes, such as critical thinking, to be included as a focus of education. Old standards of being able to score well on a standardized test of basic skills, cannot be the only means by which the academic success or failure of our students can be judged (Huitt, 1992). Oliver (2001) argues that critical thinking skills represent an important issue for education and that these skills are particularly important nowadays in order to make meaningful use of electronic information. In this respect, collaborative learning is desirable but only when grounded in disciplined critical thinking.

But although most educators agree on the importance of critical thinking for learning, there is no real agreement yet on the exact meaning of the term 'critical thinking'. For this research we go along with the definitions of Chance (1986) and Scriven and Paul (1992) who respectively define critical thinking as the ability to analyze facts, generate and organize ideas, defend opinions, make comparisons, draw inferences, evaluate arguments, and solve problems (Chance, 1986) and as the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Scriven & Paul, 1992).

A number of theorists have considered critical thinking as a problem-solving process (e.g., Brookfield, 1987; Garrison, 1992). Garrison (1992) more particularly identifies five phases of critical thinking. According to his theory, critical thinkers move through the stages of identifying a problem, defining it more clearly, exploring the problem and possible solutions, evaluating their applicability, and integrating this understanding with existing knowledge. The model employed to analyze the discourse in the present study is based on Garrison's model which is a dynamic cognitive one, similar to models of problem-solving used in cognitive psychology and artificial intelligence. Although Garrison initially developed it as a means of studying individual learning, it requires shared understanding with others and is therefore suitable for studying group learning as well.

Scripting

A central topic of CSCL research is how online discussion and critical thinking in particular can be facilitated. One possible approach is to realize 'computer-supported collaboration scripts'. Collaboration scripts essentially concern activities that promote learning, but which rarely occur spontaneously within the discourse of learners (O'Donnell, 1999). Scripts can be implemented as a kind of guideline. More specifically, a script can be defined as a detailed and more explicit didactic contract between the teacher and the group of students regarding their mode of collaboration (Dillenbourg, 2002). This approach is particularly interesting to specify, sequence and eventually to allocate different learning activities to learners (Weinberger, Ertl, Fischer, & Mandl, 2005).

In this study we investigate a computer-supported collaboration script, which provides a controlled list of message types from which the student must select before replying or creating a message. In the experimental condition, students were required to tag their messages by means of knowledge types, based on the FLE3 knowledge building environment. This environment is designed to support the collaborative process of progressive inquiry learning. The basic idea is that students gain deeper understanding by engaging in a research-like process where they generate problems, formulate hypotheses, and search out explanatory scientific information collaboratively with other students (Chen, 2004). More specifically, in the discussions students were asked to label each contribution with a category reflecting one of the stages of the progressive inquiry model. The provided categories were "Problem", "My Explanation", "Scientific Explanation", "Evaluation of the Process", and "Summary". In this respect, students are asked to step back and to reflect upon the ongoing discussion and on how to contribute to optimize the debate. Moreover, the labels visualize the possible predominance or absence of one or more knowledge types. This can help students to create an overview of the knowledge-building activity as it unfolds and to improve their collaboration and ability to solve open-ended problems.

Method

Participants and Procedure

All students enrolled for the course "Instructional Sciences" participated in the present study (N=286). Students were divided into discussion groups of about 8 students, with students randomly assigned to one of the 35 groups and groups randomly assigned to the research conditions. The discussion assignment was the same for all discussion groups in the study, regardless of the research condition the groups were in. Students in the experimental condition were required to tag their contributions by means of knowledge types. The online discussion environment offered a checklist interpreting the different contribution types advancing the discussion process. For each label, students received a description of what a particular knowledge type implies in terms of a discussion contribution. Taken into account that transcripts of 35 discussion groups for 4 themes represent a massive amount of data, 9 groups (N=71) were randomly selected for analysis.

The asynchronous discussions were a formal part of the course. Students participated during a complete semester. Four successive discussion themes of two weeks each were dealt with. During the first face-to-face session of the course, the CSCL environment was demonstrated and the objectives of participating in the discussion were communicated to the students: active processing of the theoretical base introduced during weekly face-to-face working sessions and application of this knowledge while solving authentic cases. Additional information regarding the expected participation and the criteria for qualitative messages was made available on the course website.

Fourth-year students operated as online tutors to support freshmen in their discussions. A preliminary peer tutor training was organized in a three hour face-to-face session before the onset of the discussion groups. Tutors were introduced to the multidimensional nature of tutoring in order to master a relevant mix of tutoring skills.

Content Analysis

Content analysis was applied in order to study the critical thinking processes reflected in the discussions. More particularly, a content analysis scheme based on Newman, Webb, and Cochrane (1995) was used. Newman et al. (1995) developed this content analysis instrument based on Garrison's (1992) five stages of critical thinking and Henri's (1992) cognitive skills. They identify 10 critical thinking categories: relevance, importance, novelty, outside knowledge, ambiguities, linking ideas, justification, critical assessment, practical utility, and width of the discussion. For each category, a number of positive and negative indicators are formulated and most indicators are fairly obvious opposites (Newman et al., 1995). Within the framework of the present study all critical thinking categories and indicators distinguished by Newman et al. (1995) were adopted. For each of the 9 groups, the complete communication in relation to the 4 discussion assignments was analyzed. Two trained coders coded the messages independently. Inter-rater reliability was calculated and found satisfactory for each category of critical thinking.

Results and Conclusion

Through analysis of variance we contrasted students' critical thinking in the experimental labeling condition with the presence of critical thinking in the control condition. In a first step of the analysis, we compared the overall depth of critical thinking. To enable more detailed statements with regard to the differential impact of both research conditions on students' critical thinking in the discussions, in a second step the global measure of overall depth of critical thinking was split up by analyzing the ratios for each critical thinking category and the incidence of the separate critical thinking indicators in the content analysis scheme of Newman et al. (1995). In order to study the depth of critical thinking taking place in each of Garrison's stages of critical thinking (1992), in the third step of the analysis each indicator was related to the stage in which it is most expected.

The results concerning the comparison of both research conditions do not reveal an univocal image favoring one research condition. As to the overall depth of critical thinking no significant differences between the labeling and control condition were found ($F(1, 1515)=0.970$, $p=.325$). Further, the conditions did not differ significantly concerning the discussion of ambiguities ($F(1, 1511)=3.277$, $p=.070$), the width of the discussion ($F(1, 1506)=0.147$, $p=.702$), the introduction of new ideas ($F(1, 1472)=0.306$, $p=.580$) and outside knowledge ($F(1, 1345)=2.358$, $p=.125$), the linking of information ($F(1, 1343)=0.280$, $p=.597$), and the discussion of the practical utility of the shared information ($F(1, 86)=2.057$, $p=.155$). Students in the experimental condition however did significantly outperform students in the control condition with regard to the relevance ($F(1, 1515)=7.454$, $p=.006$) and importance ($F(1, 1515)=3.891$, $p=.049$) of their messages. On the other hand, the control condition attained higher critical thinking ratios for the following categories: justification ($F(1, 1304)=4.738$, $p=.030$) and critical assessment ($F(1, 750)=7.489$, $p=.006$). With regard to Garrison's stages of critical thinking (1992), the analyses reveal that students in the control condition posted significantly more messages focusing on evaluating the applicability of possible solutions to the presented problem ($F(1, 1515)=7.277$, $p=.007$), while students in the knowledge type condition posted significantly more messages focusing on integrating new knowledge with existing knowledge ($F(1, 1514)=4.473$, $p=.035$). Taking these results into account, we cannot conclude that asking students to label their contributions in the discussion has an overall positive impact on their critical thinking. This could be due to the fact that students were not very consistent in their labeling behavior. Since the discussion system does not compel students to attach a label to their contributions, it appeared that only in 49.5% of the cases students in the labeling condition actually tagged their messages by one of the categories reflecting a stage of the progressive inquiry model. Moreover, the results indicate that students' labels were rather one-sided: 40.3% of the tagged messages received the label "my explanation". These results indicate that students probably need more instructions and training before participating in discussions where they have to assign labels to messages. This finding corroborates the research of Jeong & Joung (2007) who found that students without previous training only labeled 52% of their messages correctly.

Apart from the findings that students in the experimental condition were not always consistent in their labeling behavior and relatively one-sided in the selection of a label for a specific contribution, the equivocal results concerning the distinction between both research conditions could be due to the tutor support that the groups experienced as well. Research more specifically indicates that different tutor styles can be distinguished, leading to a diversity of supportive behavior (De Smet, Van Keer, & Valcke, in press). To verify this hypothesis concerning the impact of differential tutor support, the abovementioned analyses of variance were repeated, including tutor variables as covariates in the models. More specifically, the following covariates were included: tutors' participation and presence in the discussions and the extent to which they try to elicit student contributions focusing on identifying a problem, defining it more clearly, exploring the problem and possible solutions, evaluating their applicability, and integrating this understanding with existing knowledge. The results of the analyses of covariance

corroborate the significant impact of differential tutor support. Moreover, after correction for the impact of the characteristics of tutors' contributions, a more unambiguous picture of the differences between the research conditions appears. For none of the critical thinking ratios the control condition outperformed the experimental labeling condition. No significant differences were found for the following critical thinking categories: relevance ($F(1, 1507)=1.195$, $p=.139$), width of the discussion ($F(1, 1498)=0.443$, $p=.506$), outside knowledge ($F(1, 1337)=2.181$, $p=.140$), justification ($F(1, 1296)=0.447$, $p=.504$), and utility ($F(1, 78)=0.515$, $p=.475$). Further, the results indicate significantly higher critical thinking ratios for the overall depth of critical thinking ($F(1, 1507)=11.480$, $p=.001$), the importance of the contributions ($F(1, 1506)=15.862$, $p<.001$), the discussion of ambiguities ($F(1, 1503)=9.166$, $p=.003$), the input of new information and ideas ($F(1, 1464)=6.707$, $p=.010$), the linking of information ($F(1, 1335)=5.658$, $p=.018$), and for the critical assessment ($F(1, 742)=5.591$, $p=.018$) reflected in messages in the condition in which students tagged their messages by means of knowledge types. With regard to Garrison's stages of critical thinking (1992), the analyses reveal that students in the knowledge type condition posted significantly more messages focusing on defining the problem ($F(1, 1506)=13.205$, $p<.000$) and on integrating the new knowledge with existing knowledge ($F(1, 1506)=16.725$, $p<.000$).
These results are in line with the suggestion of Jeong & Joung (2007) who claimed that asking students to label their messages could improve argumentation but only under certain circumstances and when additional strategies are introduced. Involving peer tutors in the discussion can be seen as a possible way to make scripting by labeling work.

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