Using Representational Tools to Support Historical Reasoning in Computer-supported Collaborative Learning

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ABSTRACT In this article the authors focus on how features of a computer-supported collaborative learning (CSCL) environment can elicit and support domain-specific reasoning and more specifically historical reasoning. The CSCL environment enables students to collaborate on a historical inquiry task and in writing an argumentative essay. In order to support historical reasoning the authors compared two representational tools: a graphical representation (argumentative diagram) and a linear representation (argument list). As it is assumed that an argumentative diagram can support both cognitive and interaction processes, it was expected that using this tool would result in more qualitative historical reasoning, in the chat as well as in the essay. However, the results of this study did not show a significant difference in the amount of historical reasoning between the two conditions. A possible explanation can be found in the way the students make use of the representational tool while executing the task. The tool does not only function as a cognitive tool that can elicit elaborate activities, but also as a tool through which students communicate.

Introduction

A computer-supported collaborative learning (CSCL) environment is a learning environment in which a large amount of information can be easily accessed, and in which knowledge can be shared and co-constructed through computer-mediated communication and joint construction of products. It is believed that especially these groupware characteristics make CSCL an environment with much potential to provoke and support the construction of knowledge (Lethinen et al, 2001). However, using a CSCL environment is no guarantee of productive student interaction or positive

effects on learning. Research on collaborative learning has shown that meaningful learning is related to the quality of the interaction processes (Van der Linden et al, 2000). The design of the task and the tools that are available can be considered important factors that affect the quality of the student interaction (O'Donnell, 1999; Van Boxtel, 2000). Our main interest in this research project is how features of task and tools in a CSCL environment can elicit and support interaction processes that contribute to the learning of history.

Studying interaction processes from different (theoretical) perspectives may give more insight into the complex relation between collaborative learning tasks, interaction processes and learning outcomes (Van Boxtel, 2004). We study peer interaction from three perspectives: a domain-specific perspective, an elaboration perspective and a co-construction perspective. First, from the domain-specific perspective the main focus is on the content of the student interaction. The domain of history is central in this research project and we are specifically interested in the improvement of historical reasoning within an inquiry task. Historical reasoning implies that students situate historical phenomena in time, that they describe and explain historical phenomena, distinguish processes of change and continuity, consider the trustworthiness and value of sources and support their viewpoint or opinions with arguments. Reasoning within the domain of history also involves the use of historical concepts. From the elaboration perspective, the importance of elaboration in peer interaction is emphasised. The idea of elaboration is based on the constructivist idea that knowledge is not transmitted or passively received, but actively constructed (Brown et al, 1989). Interaction processes, such as asking and answering questions, reasoning and argumentation to resolve controversy, elicit deep processing and therefore contribute to positive learning results. A third way to study the relationship between student interaction and meaningful learning is to put in focus the co-construction of knowledge. In recent years, especially from a sociocultural perspective on learning, the joint and situated construction of meanings through communication and the role of mediational tools have been emphasised. When students work on a common task, mutual understanding must be created and sustained continuously (Roschelle, 1992). Knowledge can be co-constructed through the elaboration, transformation or integration of one another's ideas. Each participant actively contributes to the process of knowledge building. We consider interaction episodes that contain all three above-mentioned aspects important for learning history. We will refer to this by the term *co-elaborated historical reasoning*. Thus, by co-elaborated historical reasoning we mean elaborate historical reasoning episodes in which both students contribute to the elaboration and the co-construction of meaning.

The main aim of our research is to elicit and promote co-elaborated historical reasoning in a CSCL environment. We use a groupware environment that was developed to support collaborative writing. In this environment students can use a shared text processor, shared supportive tools, a private notepad and can access external information sources. All communication between the collaborating students takes place by an integrated chat facility. The program automatically logs the chat and writing activities of the students. We conducted a first study to investigate whether and how students reasoned historically in a CSCL environment, and what difficulties they faced. The students, who worked in dyads, had to study several historical sources and collaboratively write an essay. The results indicated that, although the chat protocols showed some historical reasoning, this reasoning was often of poor quality (Van Drie et al, in press). Nor did the chat protocols show much co-elaborated historical reasoning. The students only briefly discussed their point of view on the historical issue at hand, and which arguments they would use to support their viewpoint. Discussion about counter-arguments rarely occurred. The collaboratively written essays showed the same pattern. Based on these results we tried to support the process of historical reasoning, in the chat as well as in the essays.

In the study presented here, we have compared two different supportive tools which both make it possible to collaboratively construct an external representation of the subject at hand. Collaboratively constructing external representations can be meaningful because of their communicative and cognitive function (Suthers & Hundhausen, 2001; Erkens et al, 2002). From a communicative function perspective, it contributes to a shared understanding and a joint problem space between co-learners, and enables them to focus on salient knowledge (Crook, 1998; Veerman & Treasure-Jones, 1999; Suthers & Hundhausen, 2001). The construction of a representation supports the verbalisation of knowledge and explicit discussion in order to come to a shared understanding. From a cognitive function perspective, a graphical representation can be meaningful for two reasons. First, it focuses attention on central problems, relations and structures in the task, helping to distinguish central, main or core issues from more peripheral ones (Suthers & Hundhausen, 2001). Second, it stimulates the process of elaboration, for it can refine and structure the content of students' knowledge and makes participants aware of gaps in their knowledge, for instance about what specific relations are present or about the balance between arguments against and in favour of a position (Suthers & Hundhausen, 2003). We compared the use of a graphical representation (argumentative diagram) with a non-graphical representation (argument list). In an argumentative diagram students can represent different arguments pro and contra and relate these to each other by using

arrows. In an argument list the latter is not possible, the arguments pro and contra can only be listed below each other. By comparing these two types of representation, we tried to get more insight in how the collaborative use of these representational tools influences the amount and quality of historical reasoning in the chat and essay. It is expected that the collaborative construction of an argumentative diagram, in comparison with the argument list, will elicit more interaction about the arguments and the relations between the arguments, and will show more co-elaborated historical reasoning. We also expect that the amount of arguments pro and contra is more balanced in the diagram, for the diagram makes the amount of arguments pro and contra more directly visible compared to the argument list. Concerning the learning outcomes, it is expected that the students in the diagram condition produce essays of higher quality and have higher scores on the (individual) post-test.

Method

Design

The main question of this study is in which way the collaborative construction of a graphical representational (argumentative diagram) in a CSCL environment, compared to linear representation (argument list), affects the amount of co-elaborated historical reasoning in the chat dialogue, the quality of the essays produced and individual learning outcomes. Subjects of the study were 72 students (36 dyads) from three history classes in pre-university education (aged 16-17). The experiment took place at school, during the history lessons and lasted for six lessons (of 50 minutes) spread over two weeks. A pre-test and post-test were made to indicate learning outcomes.

The students were randomly assigned to pairs and the pairs were randomly assigned to one of the conditions. For practical and organisational reasons members of pairs belonged to the same history class. When a student missed more than one lesson, the pair to which he or she belonged was excluded from the analyses. The analyses included 16 student pairs in the diagram condition, and 14 in the list condition.

The students had to perform a historical inquiry task, which involved studying historical sources (such as descriptive texts from textbooks, different interpretations of historians, photos, tables and interviews) and writing an essay of approximately 1000 words. The task was about the question as to whether the changes in the behaviour of Dutch youth in the sixties were revolutionary or not. This question focuses especially on one aspect of historical reasoning: taking a point of view and supporting this with arguments. The representational tools are expected to support this process of argumentation, for in the tool students can represent and

organise the arguments pro and contra which they have found in the historical sources. The students did not receive instruction on the subject in advance.

The students worked in a computer-supported learning environment called *Virtual Collaborative Research Institute* (*VCRI*; see http://edugate.fss.uu.nl/vcri; Jaspers & Erkens, 2002). *VCRI* is a groupware program that enables students to work collaboratively on inquiry tasks and essay writing. Each student works at one computer, physically separated from the partner. Communication takes place by means of chat. Figure 1 shows the main screen of *VCRI* in the diagram condition. Information about the task and relevant historical sources can be found in the database menu. The upper left window contains a chat facility and the chat history. The lower left window contains a shared text processor that can be used by taking turns. The upper right window contains a private notepad. In the lower right window the representational tool is shown, in this figure the diagram. Both representational tools (diagram and list) are shared tools.

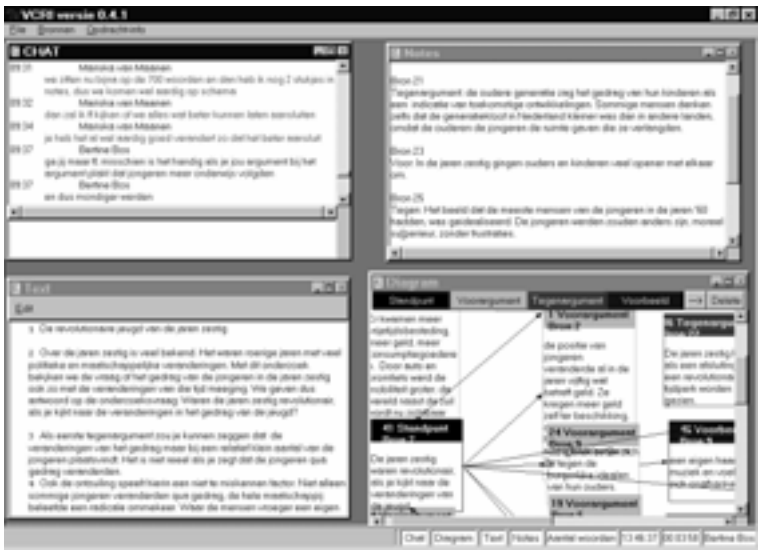
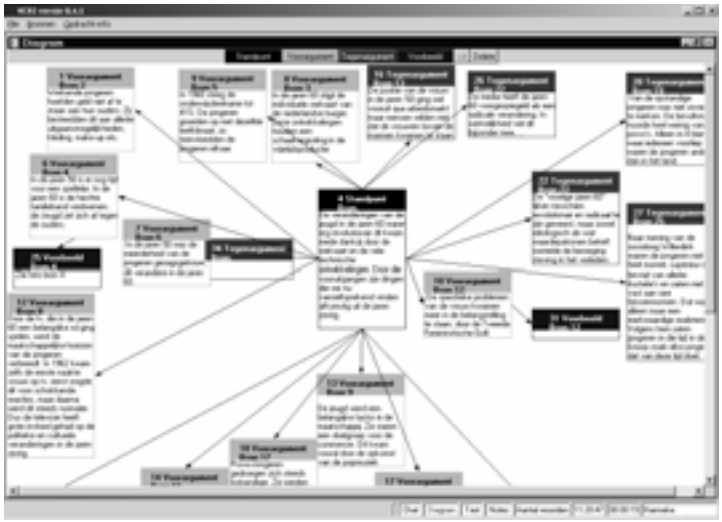


Figure 1. The main screen of *VCRI* for the diagram condition.

In Figure 2 the diagram is represented. In the diagram several text boxes can be used: Viewpoint, Argument pro, Argument contra and Example. The text boxes can be linked by arrows. Furthermore, it is possible to refer to the source from which the argument or the example derives. The list is shown in Figure 3. The list window consists of an empty text box in which the arguments can be collected and organised.



Legend: Standpunt = standpoint; Voorargument = argument pro; Tegenargument = argument contra; Voorbeeld = example

Figure 2. Example of a diagram constructed by one of the dyads (in Dutch).

Figure 3. Example of a list constructed by one of the dyads (translated from Dutch).

Analyses

We analysed the interaction processes in the chat protocols, the quality of the collaboratively produced diagrams and argument lists, the collaboratively written essays and the results on the individual post-tests. First, the interaction in the chat protocols was coded, by using *MEPA*, a computer program for Multiple Episode Protocol Analysis (Erkens, 2002, see http://edugate.fss.uu.nl/mepa). The interaction processes were coded on the level of utterances and were analysed on the dimension of task acts. In Table I the coding definitions of the task acts can be found. Five main categories were distinguished: utterances related to the content of the task at hand (Task), and procedures to perform the task (Procedure), talk about the technical functioning of the computer program (Program), social talk (Social), and greetings at the start or ending of a working period (Greetings). The categories Task and Procedure were coded in subcategories.

Category	Description
Task	*Expressions concerning the content of the task*
– Historical reasoning	Discussion of the historical content of the task
– Tool	Concerning the construction of the representational tool
– Text construction	Concerning the construction and structure of the text
– Revision	Discussion of revision or addition of specific text
– Goal	Concerning verification of meeting task demands
– Info	Concerning the use of the information sources
– Evaluation	Evaluating the content of the task, the representational tool, or text
– Word count	Concerning checking the number of words written
Procedure	*Expressions concerning the organisation and planning of the task*
– Coordination	Concerning coordination of actions
– Task approach	Concerning the general approach of the task
– Planning	Concerning coordination of time
– Turn-taking	Coordination of turn-taking
– Evaluation	Concerning the evaluation of the task approach or organisation
Program	About technical aspects and program-related matters
Social	Concerning topics not related to the task or the program, but with a social function
Greetings	Greetings at the beginning or end of a working session
No code	Utterances that could not be coded as one of the previous categories

Table I. Coding definitions for the task acts (chat dialogue).

Second, the utterances that were coded 'historical reasoning' were further analysed and coded as co-elaboration whenever the reasoning contained an elaboration constructed by both students. Table II shows an example of co-elaborated historical reasoning. In this example Paula and Wendy discuss their point of view on the question of whether the sixties were revolutionary or not. Paula and Wendy co-construct their meaning on this subject. First, they talk about which point of view they are taking, and whether they both agree on this. They ask questions which elicit elaboration, such as 'What is our opinion?', 'Why?' and 'Which arguments pro are we going to use?' They both, in turn, add arguments to support their meaning, and they elaborate upon the reasoning of the partner, as is shown in lines 16 and 17.

1	Paula	But what is our opinion?
2	Wendy	To start with, what is your opinion?
3	Paula	The sixties were revolutionary.
4	Wendy	Why?
5	Paula.	Because the consequences are still noticeable now.
6	Wendy.	Okay, that is true.
7	Paula	But it already started in '50.
8	Wendy	That's true too, but that's got little to do with the revolutionariousness, so the sixties were indeed revolutionary!?
9	Paula	If you think so too.
10	Wendy	Yes, sure I do too.
11	Paula	Okay.
12	Wendy	Which arguments pro are we going to use?
13	Paula	That young people became a group, and that they had their own opinion.
14	Wendy	The depillarization* went on strongly.
15	Paula	Yes, and the consumptive society arose.
16	Wendy	People started to think more flexible about sex, which meant greater freedom for young people.
17	Paula	Yes, young people had more freedom anyway, because of their being financially independent they were able to leave their parents more early and they were independent of their parents.
18	Wendy	Exactly.
19	Paula	Okay.

* Depillarisation refers to the breakdown of the strict division in socio-religious groups or pillars (Protestants, Catholics, Socialists, and Liberalists) that existed in Dutch society from the beginning of the twentieth century.

Table II. Example of co-elaborated historical reasoning (fragment of chat protocol, translated from Dutch).

The inter-rater agreement for the analyses of the chat protocols was calculated over three randomly chosen protocols from a pilot study (in sum

1333 utterances). Cohen's Kappa turned out to be satisfactory (see Table III). Difficulties were found especially in deciding when a new category started. Sometimes the difference between two subcategories was not so clear, for instance between Coordination and Approach.

Variable	Cohen's Kappa
Main categories task acts	.77
Task categories	.85
Procedure categories	.83
Elaboration in historical reasoning	.94
Co-construction in historical reasoning	.95

Table III. Inter-rater reliability (Cohen's Kappa) of the coding of the chat utterances.

Furthermore, we analysed the symmetry in the participation between the two students. Equal participation is considered an indication for co-construction. We measured asymmetry in participation as the mean percentages deviation from an equal distribution of chat, tool and essay contributions of the dyads.

The essays were analysed on six aspects of historical reasoning: time references, changes and continuity, explanations, use of sources, argumentation, and the use of historical concepts. On each of these aspects we scored both the amount and quality (for example, the amount of explanations given, and the quality of the explanations given). We added a score about the structure of the essay. The maximum score on the essay was 60 points. Two researchers independently judged the essays and differences were discussed until agreement was reached.

The representational tool (diagram and argument list) aimed at supporting the process of argumentation, by representing and organising arguments. The diagrams and lists were therefore analysed on the number of arguments pro and contra that were represented. The inter-rater reliability (Cohen's Kappa) over 12 randomly chosen representations, was for the arguments pro .89 and for the arguments contra .78. We also counted the number of sources referred to in the representation; the total number of arguments used (arguments pro plus arguments contra) and the balance of arguments pro and contra. The balance refers to the difference between the number of arguments pro and the arguments contra. So, a higher score means less balance. We have to take into account that more arguments pro could be identified compared to arguments contra. In sum, 16 arguments pro could be identified from the sources and 10 arguments contra.

The pre-test and post-test focused on subject knowledge about the sixties, for the aim of the task is to improve subject-matter knowledge. The test contained seven open-answer questions and one closed question. The items were constructed in line with the different aspects of historical

reasoning (for example, a question about what changed in the sixties, what caused the changes, meaning of concepts). The pre-test and post-test consisted of the same questions; only different historical sources (for example a different picture or source) were used. The maximum score on both tests was 79. The inter-rater reliability of the test items was calculated over the tests from 10 randomly chosen students, and varied between .70 and 1.00 (Cohen's Kappa).

Results

In this section we will consequently report the results regarding the interaction in the chat, the quality of the constructed representation, the essay and the pre-test and post-test. Two conditions will be compared, the argumentative diagram and the argument list. The results of the pre-test showed no significant differences between the two conditions on their subject knowledge (t (58) = .27, p = .79). The mean length of the chat protocols was 293.33 utterances (SD 138.61). There were no significant differences in the number of utterances between the two conditions.

The chat protocols were first analysed on the level of task acts. Table IV shows the mean percentages and standard deviations for the complete sample, and the mean frequencies and standard deviations for the two conditions. Most of the chat utterances were concerned with the task (31%) and procedures to perform the task (44%). A lot of utterances (28%) were concerned with the coordination of activities, for example exchanging what one is doing at the moment. About 18% of all utterances did not relate to the task at hand (Social or Greetings). Historical reasoning was found in about 6% of the utterances. The high standard deviations on all categories indicate that the chat protocols showed a lot of variation.

Did the diagram and list influence the type of interaction in the chat protocols? To test whether there were differences between the two conditions, we first conducted a MANOVA on the frequencies for the variable Task. For some of the subcategories (Text construction, Info, Revision, Tool and Word count), however, the variances were not homogenous for a higher mean score went together with a higher standard deviation. We tested the difference on both conditions and found a significant overall effect (F (8, 21) = 5.02, $p \leq .001$). A significant difference was found for the categories Tool (F (1, 28) = 7.24, $p \leq .01$) and Text construction (F (1, 28) = 7.87, $p \leq .01$). So, students who worked in the diagram condition produced significantly more utterances that were related to the use of the tool than students who worked in the list condition. The students who worked with the list, however, talked more about the construction of the essay. No differences were found in the amount of

historical reasoning. Second, we conducted a MANOVA for the category Procedure, but no significant difference was found.

Task acts	Diagram (n = 16)	List (n = 14)	Total (n = 30)	
	M (SD)	M (SD)	M (SD)	%
Task	77.3 (30.6)	102.1 (52.5)	88.8 (43.4)	31.1
Historical reasoning	16.4 (14.3)	17.6 (11.0)	17.0 (12.6)	6.3
Tool	19.8 (14.2)	8.6 (6.7)	14.5 (12.5)	5.1
Text construction	11.5 (6.9)	22.0 (13.1)	16.4 (11.4)	6.3
Revision	4.3 (3.8)	12.1 (15.6)	7.9 (11.5)	2.1
Goal	8.2 (5.7)	13.4 (14.2)	10.6 (10.7)	3.8
Info	3.0 (3.8)	7.1 (9.1)	4.9 (7.0)	1.4
Evaluation	8.5 (4.8)	10.1 (8.3)	9.2 (6.6)	3.4
Word count	5.4 (3.6)	10.1 (9.1)	7.6 (7.0)	2.7
Procedure	121.4 (60.6)	132.4 (80.0)	126.6 (69.3)	43.9
Coordination	75.6 (44.9)	90.5 (53.0)	82.6 (48.6)	27.6
Task approach	18.6 (10.6)	20.7 (8.6)	19.6 (9.6)	7.4
Planning	7.3 (4.6)	7.6 (7.3)	7.4 (5.9)	2.5
Turn-taking	17.7 (15.5)	16.1 (13.8)	17.0 (14.5)	6.1
Evaluation	2.3 (2.7)	2.6 (3.9)	2.4 (3.3)	0.2
Program	17.6 (15.3)	28.0 (28.6)	22.4 (22.7)	6.9
Social	35.9 (43.0)	29.3 (25.2)	32.8 (35.4)	10.0
Greetings	19.5 (8.5)	23.1 (8.8)	21.2 (8.7)	8.1
No Code	0.4 (1.8)	0.0 (0.0)	0.2 (1.3)	0.1

Table IV. Mean frequencies and standard deviations of task acts in the chat protocols for the two conditions and total percentages.

Next, we analysed whether there were differences in the amount of co-elaborated historical reasoning between the conditions. It was expected that the students in the diagram condition would show more co-elaborated historical reasoning in the chat. However, a *t*-test for independent samples revealed no significant differences on co-elaborated historical reasoning (Mdiagram = 6.69, SDdiagram = 10.04; Mlist = 9.64, SDlist = 10.26; t (28) = .80, p = .43). So, the use of a diagram or list did not result in a difference in the amount of co-elaborated historical reasoning in the chat discussions.

Did both students equally contribute to the different parts of the task? We looked more closely at the number of contributions of both students in the chat, in the construction of the representation and in the constructions of the essay. Equality in participation is here considered as an indicator for the co-construction of knowledge. In Table V the results of this analysis are presented. This table shows that the participation in the chat is leaning to equality (only 8-18% asymmetry). The contributions to the tool products (27%) and to the essay (40%) are less equally distributed. We compared the

conditions by using a *t*-test for independent samples. This test reveals that in the diagram condition the chat contributions are more equally distributed, compared to the list condition (t (28) = 3.1; $p \leq .01$). We found no differences in the equality of the contributions for the construction of the tool and the essay.

	Diagram (n = 16)	List (n = 14)		
	M (SD)	M (SD)	*t*	*p*
Chat	8.8 (8.4)	18.1 (8.2)	3.053	.005*
Representation	27.1 (17.0)	27.7 (19.4)	.090	.928
Essay	41.8 (34.2)	37.1 (27.4)	.412	.684

* $p \leq .05$.

Table V. Mean scores in percentages and standard deviations of asymmetry in contributions on chat, representation and essay and results of *t*-tests for independent samples for the two conditions.

Next we measured the argumentative quality of the diagrams and argument lists the students collaboratively constructed. Table VI shows the results for both conditions, and the results of a *t*-test for independent samples. The *t*-test for independent samples showed that the students working with the list mentioned significantly more arguments, pro as well as contra. The balance between the arguments pro and contra was the same for both conditions. In the list condition the students used significantly more sources.

	Diagram (n = 16)	List (n = 14)		
	M (SD)	M (SD)	*t*	*p*
Total arguments	13.5 (3.7)	17.6 (3.1)	3.314	.003*
Arguments pro	8.9 (2.4)	10.9 (1.6)	2.757	.011*
Arguments contra	4.6 (1.9)	6.7 (2.5)	2.556	.015*
Balance	4.3 (2.3)	4.2 (2.8)	.038	.970
Sources	14.3 (4.8)	20.9 (4.5)	3.828	.001*

* $p \leq .05$

Table VI. Mean scores and standard deviations on the number of arguments pro and contra for the two conditions and results of *t*-tests for independent samples.

Secondly, we measured learning outcomes by 1. the quality of the essay and 2. the results of the post-test compared to the pre-test. Table VII shows, for both conditions, the mean scores of the essay, the pre-test and the post-test and the results of the *t*-tests for independent samples. First, the overall

quality of the essay did not show significant differences between the two conditions. Additional analyses showed that the list condition mentioned more arguments contra in their essays compared to the diagram condition (Mdiagram = 1.44, SD = 1.0; Mlist = 2.2, SD = 0.7; t (28) = 2.49; $p \leq .05$). There was no difference in the number of arguments pro, the quality of the argumentation pro as well as contra, nor in the other aspects the essay was scored on. Second, we analysed the outcomes on the pre-test and post-test. A t-test for paired samples showed that in general the students significantly improved on the post-test compared to the pre-test (t (58) = 16.46, $p \leq .000$). On all the items of the test the students showed significant improvements. However, there were no significant differences between the two conditions found on the scores of the post-test (see Table VII). Thus, the construction of the diagram or the list did not result in differences in the overall quality of the collaboratively written essays and in the scores on the individual post-test.

	Diagram (n = 32)		List (n = 28)			
	M	SD	M	SD	t	p
Essay*	36.6	5.3	38.9	5.1	1.206	.239
Pre-test	30.4	4.7	30.7	6.1	.273	.786
Post-test	45.9	7.5	46.7	6.6	.421	.672

* $p \leq .05$.
*Essay was measured on the level of pairs (Diagram: n = 16; List: n = 14).

Table VII. Mean scores and standard deviations of the learning outcomes for the two conditions and results of t-tests for independent samples.

Conclusions and Discussion

In this study we investigated the influence of collaboratively constructing an external representation in CSCL on the historical reasoning process in chat communication and in writing an essay. We compared the construction of two types of representation: an argumentative diagram in which the arguments are graphically represented and an argument list in which the arguments are represented in a non-graphical or linear way. We expected that the collaborative construction of a diagram, compared to the construction of a list, would elicit more historical reasoning and more co-elaborated historical reasoning in the chat interaction, and therefore would result in higher scores on the essay and the post-test. Our findings did not support our expectations. We will first turn to the analysis of the collaborative process. The chat protocols showed only a limited amount of co-elaborated historical reasoning. A large part of the interaction in the chat protocols was about procedures, especially about the coordination of activities, which is considered important for collaborative learning (Erkens et

al, in press). The construction of the diagram or list did not result in significant differences in the amount of historical reasoning in the chat, nor in the amount of co-elaboration. When we look at the symmetry of the contributions of the students while working on the task, we can conclude that this task in this CSCL environment elicits equal participation from the students. Especially, the contributions in the chat were approaching symmetry, whereas the contributions to the representational tool and essay were somewhat more asymmetric. We found that the contributions in the chat were more symmetric in the diagram condition compared to the list condition. Although the symmetry of the contributions gives some insight into the collaborative process and an indication of co-construction, it does not give any information on the quality of the contributions. We are planning to extend our analyses with qualitative information on the quality of the contributions of the different students.

How can it be explained that the use of the diagram did not provoke more co-elaborated historical reasoning? One explanation might be that the use of the tools requires that the students learn how to use the tool and that this increases the amount of activities the students have to perform during the task. This may have resulted in a cognitive overload. A second (and complementary) explanation might be that historical reasoning takes place not only in the chat discussion but also through the use of the tools. If a student adds an argument in the diagram, list or essay, he or she does not mention it in the chat. However, by adding it in the tool, the argument is in a way communicated to the other student and becomes part of the shared context. The fact that the argumentation in the tool products and in the essay is of reasonable quality brings us to the conclusion that the tool does not only function as a cognitive tool that can elicit elaborative activities, but as a tool through which students communicate and co-elaborate. A third aspect is that the chat protocols showed that students have a tendency to accept one another's contributions very easily and without criticism. We hardly found any critical comments, such as 'this argument is not well formulated', 'this is not a good argument', 'this argument should be placed elsewhere'. This tendency might be explained by the educational context in which not much attention is given to critical reflection on one's own or other students' contributions, and students' tendency to be more focused on the product than on deep learning (Veerman, 2000). Erkens et al (in press) give another explanation by referring to the inherent necessity in a collaborative learning task to establish agreement. Therefore, students will try to reach agreement and will not often be very critical of each other's contributions.

Although all students improved on the post-test compared to the pre-test, the results of the post-test did not show differences between the two conditions. Nor did we find significant differences on the overall quality of

the essays produced, although the students in the list condition represented significantly more arguments contra in their essays, compared to those in the diagram condition. With regard to the constructed representations, the results showed that the lists contained significantly more arguments, pro as well as contra. This is in line with the outcome that in the list more sources were used (about 20) compared to the students in the diagram condition (about 14). The number of sources used can explain the difference in number of arguments contra given in the essays. This result suggests that the list, compared to the diagram, might be more suitable for representing a large number of arguments. The main difference between the list and the diagram can be found in the possibility of organising the arguments graphically and to interrelate the arguments with links. However, a diagram might become too complex and too hard to organise when a lot of information has to be presented. So, the representational format of the list, in comparison to the format of the diagram, might be better suited for this inquiry task that included the study of a lot of sources. An additional explanation for the finding that the quality of the essays in the diagram condition was not higher compared to the list condition, might be that the students in the list condition were more able to use their listed arguments for writing the essay. The arguments in the diagram were often short and to the point, whereas the arguments in the lists were more extended and seemed sometimes more a summary of the source. Moreover, in educational practice, students are more experienced in organising arguments in a list than in a diagram. To verify the assumption that the way the arguments were presented in the list may be more helpful for writing the essay, we are planning additional analyses, which include the congruence of the arguments in the representation and in the essay.

In sum, this study shows that a collaborative writing task in a CSCL environment is a useful task to engage students in historical reasoning activities. The results of this study suggest that this domain-specific reasoning does not occur mainly in the chat interaction, but in and through the products the students are working on (such as the diagram, list or essay). The chat facility is mainly used for the coordination of activities between the students. Thus, when investigating the effects of tools on the interaction process in a CSCL environment, one should also take into account that interaction does not only take place in the chat, but also in and through the available tools and products. Interaction analyses should therefore integrate contributions in the chat and in the tools. With regard to the representational tools we compared, the results suggest that the list is more suited to presenting a large amount of information, whereas the diagram focuses more on the organisation of the arguments. However, the representational tools we compared did not seem to be of influence on the amount of co-elaborated historical reasoning in the chat, the quality of the

essay or the results of the post-test. So, which type of representation is most suitable to the task seems also to be related to the amount of information that needs to be represented and the experience students have in construction and using the representation for text writing.

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