

Learning about the past with new technologies

Fostering historical reasoning in computer-supported collaborative learning

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Leren over het verleden met nieuwe technologieën

Bevorderen van historisch redeneren in computerondersteund samenwerkend leren

(met een samenvatting in het Nederlands)

Proefschrift

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Paul *Zouden ze echt deze hele chats gaan lezen?*
Floris *Pff dunno*
Paul *Ik zou wel wat beters te doen hebben als ik aan de universiteit studeerde/les gaf*

Fragment van een chat-discussie uit studie 1

Paul *Do you really think they will read this complete chat discussion?*
Floris *Pff dunno*
Paul *I would have better things to do, if I worked for the university*

Fragment of a chat discussion from study 1

Woord vooraf

Tijdens mijn studie Onderwijskunde midden jaren negentig, verbaasde ik mij er meer en meer over dat er zo weinig onderzoek werd verricht naar leren bij het vak geschiedenis. Nu, 10 jaar later, ligt er dit proefschrift over historisch redeneren in een elektronische leeromgeving. Het is één van de eerste onderzoeken in Nederland dat vanuit onderwijskundig perspectief kijkt naar hoe leerlingen redeneren en leren bij geschiedenis.

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Jannet van Drie

Gouda, oktober 2005

CONTENTS

CHAPTER 1	GENERAL INTRODUCTION	1
1.1	Scope and aim of the thesis.....	1
1.2	Structure of the thesis.....	4
CHAPTER 2	THEORETICAL FRAMEWORK	7
2.1	Learning history through reasoning.....	7
2.2	Writing and historical reasoning.....	19
2.3	Collaboration and historical reasoning.....	24
2.4	Computer-support for collaborative writing in history	29
2.5	Conclusions and research question	35
CHAPTER 3	METHOD OF THE STUDIES	39
3.1	Research questions and design.....	39
3.2	Participants.....	41
3.3	Learning environment and task	42
3.4	Procedure	44
3.5	The conditions: Types of inquiry questions and representational tools	45
3.6	Instruments and analyses	50
CHAPTER 4	HISTORICAL REASONING IN A COMPUTER SUPPORTED COLLABORATIVE LEARNING ENVIRONMENT.....	63
4.1	Introduction.....	63
4.2	Historical reasoning	64
4.3	Historical inquiry tasks.....	68
4.4	Method	70
4.5	Analyses	71
4.6	Results	76
4.7	Conclusions and discussion	83
4.8	Additional analysis: Elaboration	86
CHAPTER 5	USING REPRESENTATIONAL TOOLS TO SUPPORT HISTORICAL REASONING IN COMPUTER-SUPPORTED COLLABORATIVE LEARNING.....	89
	Abstract	89
5.1	Introduction.....	89
5.2	Method	91
5.3	Results	97
5.4	Conclusions and Discussion.....	100
CHAPTER 6	EFFECTS OF REPRESENTATIONAL GUIDANCE ON DOMAIN SPECIFIC REASONING.....	103
	Abstract	103
6.1	Introduction.....	103
6.2	The potential of external representations.....	105
6.3	Aim of the study	107
6.4	Method	107
6.5	Results	116
6.6	Conclusions and discussion	125
CHAPTER 7	CONCLUSIONS, DISCUSSION AND IMPLICATIONS	129
7.1	Study 1: CSCL, historical reasoning, and the writing task	129
7.2	Study 2: Effects of the collaborative construction of external representations.....	131
7.3	General considerations	143

7.4	Methodological considerations.....	146
7.5	Practical implications	149
	REFERENCES.....	153
	APPENDICES.....	171
	SUMMARY	189
	SAMENVATTING	197
	CURRICULUM VITAE	207
	LIST OF PUBLICATIONS	208

CHAPTER 1 GENERAL INTRODUCTION

1.1 Scope and aim of the thesis

History education is currently the topic of much public debate in the Netherlands, a debate similar to that in other countries, such as Great Britain and the United States. As can be gleaned from a few of the recent headlines in the Dutch press, one of the major concerns spurring the debate is the presumed lack of knowledge about historical facts: “What everyone should know about the national past”, “Life is poor without history”, “Who was Adolf Hitler?”, “Teach history the same as arithmetic and reading”, “When was that date?” (see NRC Handelsblad, 2005). This perceived lack in itself is no recent issue. As shown by Wineburg (2001), already in the 1920’s people performed poorly on history tests and were not able to memorize dates and facts. Nevertheless, the major part of the ensuing public debate is narrowed down to the issue of the content of history education: what specific topics and facts of our national past should be known by everyone and therefore be part of the history curriculum? The question of what to teach in school history is closely related to the question of why specific historical facts should be known, an aspect largely left out of the current debate (Grever & Ribbens, 2004).

History education has more to offer to the education of democratic citizens than learning facts alone (cf. Barton & Levstik, 2004). Current societal changes, such as the rise of the multicultural society and the increased importance of the European Union, have prompted the question of how school history can contribute to the education of future citizens. Important questions, amongst others, in this respect are how to prepare young citizens for the 21st-century global society, how to contribute to international cooperation and integration without neglecting the controversial parts of history, and how to balance and connect the local, national, European and world dimension (Van der Leeuw-Roord, 2005). These questions require answers that go beyond what facts should be learned, and into an understanding of how students learn and reason about the past.

The present thesis focuses on this latter issue of how students learn and reason about the past, in particular when using computer technology. Recent technological developments have provided new learning environments to support learning processes, resulting in new questions for educational research, such as how characteristics of these learning environments shape the process of learning in specific domains. The (possible) facilitating role of computer technology in fostering learning and reasoning in history has, thus far, hardly been investigated. The aim of this study is to investigate how the collaborative construction of different external representations in CSCL affects historical reasoning in chat dialogues and in collaborative text writing.

In this thesis a socio-constructivist perspective on learning is adopted, in which learning is viewed as an active and social process, mediated through language and cultural artifacts (Brown, Collins, & Duguid, 1989; Säljö, 1995; Wertsch, 1991). History learning is thus not viewed here as

remembering important facts and data from the past, but as reasoning with these facts. The active use of knowledge of the past while reasoning is considered to be important for learning history. Historical reasoning is one of the main constructs of the present thesis, and a large part of this thesis will be dedicated to the analysis of students' (collaborative) historical reasoning in dialogue and writing.

As Voss and Carretero (1998b) have pointed out, the study of learning in history is not only important in itself, but it raises issues that are not or less apparent in other subject areas, such as the relatively few basic concepts of history and the special characteristics of historical information and explanation, and it offers good opportunities to study the development of student reasoning skills as it is a highly verbalized subject matter. Nevertheless, the domain of history has not often been the topic of study in educational research (Leinhardt, Beck, & Stainton, 1994b; Voss & Carretero, 1994, 1998b). Whereas considerable research has been devoted to understanding how students learn within the domains of mathematics and science, only few studies have appeared focusing on learning subject matters such as history and geography. It is only since the 1990s that educational researchers have shown an increased interest in the subject of history, and several studies on learning history have appeared (e.g., Carretero & Voss, 1994; Leinhardt, Beck, & Stainton, 1994a; Voss, 1997; Voss & Carretero, 1998a). These studies have been conducted from a predominantly cognitive perspective on learning, and include expert-novice comparisons, reasoning with historical documents and about historical explanations, and the teaching of history. This line of research has recently been broadened with research work from a socio-cultural perspective (e.g., Barton 2001; Barton & Levstik, 2004; Wertsch & Rozin, 1998). Despite the growing (international) body of research on learning history, much still is unknown about how students learn history and how tasks and tools can mediate this learning. The need for research into the learning of history has recently been acknowledged in the Netherlands as well (Committee of History Education, 1998; Committee of History and Social Sciences, 2001), but so far, has not yet resulted in more research publications in this domain.

The present thesis focuses on fostering historical reasoning in computer-supported collaborative learning (CSCL), through the use of external representations. CSCL offers a computer learning environment in which groups of learners can collaboratively construct knowledge through dialogue and joint representation of ideas. Research on CSCL is a relatively new field within educational research, focusing on how technology can support collaboration, enhance peer interaction, and facilitate the sharing and distribution of knowledge (Lipponen, 2002). The present research aims at fostering historical reasoning by providing domain-specific support through the joint construction of different external representations (e.g., argumentative diagram, matrix, concept map). It is assumed in this thesis that the collaborative construction of an external representation has the potential to offer support both on a cognitive and on a communicative level, and to elicit interaction processes that contribute to the learning process (Erkens, Kanselaar, Jaspers, & Schijf, 2001; Suthers & Hundhausen, 2003). What remains unclear is how different kinds of representations influence interaction and learning (Schnotz & Lowe, 2003; Suthers & Hundhausen, 2003), and research studies systematically

comparing different external representational tools in CSCL have thus far been scarce (Van Bruggen & Kirschner, 2003). With respect to our focus on writing tasks in history, it should be noted that as yet, not much is known about the relation between collaboration processes, writing strategies and the use of the computer environment (Erkens, Jaspers, (Tabachneck-) Schijf, & Prangmsma, 2001).

Studies in CSCL have been conducted from a variety of perspectives and show a large diversity in terms of length of study, participants, group size, learning tasks, methodologies, and technologies used (Lipponen, Hakkarainen, & Paavola, 2004; Strijbos, 2004). In the studies reported here, a CSCL-environment is used which enables pairs of students in pre-university education to collaborate on a history task, which includes the study of multiple sources and the writing of a text. The basic environment contains, amongst other things, a chat box, a shared text-editor, an individual notes box and a set of information sources. In two experimental studies we investigate whether a collaborative writing task in CSCL elicits historical reasoning, how this reasoning is influenced by the question posed, and how the joint construction of external representations influences historical reasoning in dialogue and writing. In the second of the two studies the effects of different representational tools will be compared to one another and to a control group. Analyses in CSCL-research often include analyses of the interaction process, taking place between the learners. In general, these analyses are oriented toward the generic features of the interaction and their relation to learning, with little attention for domain-specific aspects of the interaction (Fischer, Bruhn, Gräsel, & Mandl, 2002). In our approach, especially the domain-specific aspects of the dialogue will be highlighted. In addition to this interaction analysis, our analyses will also include the jointly constructed products and individual learning outcomes. By examining both learning processes and outcomes in the different conditions, we intend to gain insight into the way that the joint construction of external representations shapes the process of knowledge construction in history learning. In so doing, the present thesis aims to contribute to a better understanding of learning history, the facilitating role of CSCL in fostering historical reasoning, and the interplay between task, tools (especially external representational tools), interaction processes, and learning outcomes.

This thesis addresses the perceived more general need for insight into how computer technology can be used in relation to the development of domain-specific knowledge and skills (Ten Brummelhuis, 2002). The insights from this study could contribute to the development of CSCL-environments and other collaborative tasks oriented towards fostering historical reasoning. An investigation conducted on behalf of the Dutch Inspectorate of Education recently showed that despite the fact that computers are increasingly being used in Dutch secondary education, computer technology is not frequently used in history education, nor to facilitate collaborative learning (Kral, Van der Mooren, Van der Neut, Van Poppel, & Uerz, 2002). Within school history, computer technology is mainly used for its possibility to provide access to large amounts of information. For the learning of history it is, however, more important what students actually do with the information, than whether they are able to find this information. Or, as Haydn (2000) stated, “The key to developing

pupils' understanding in history is their ability to analyze and deploy information *after* they have accessed it" (italics added, p. 103). Whether and how CSCL may contribute to learners' understanding and reasoning in history is investigated in this thesis.

1.2 Structure of the thesis

This first chapter provides a general introduction to the present thesis and presents its general aim. In addition it describes the organization of the thesis.

Chapter 2 describes the theoretical framework underlying our research and provides definitions of the main concepts. The concept "historical reasoning" is introduced as important to history learning, and several components of historical reasoning are described and discussed. Next, two strategies are discussed that can be used to engage students in historical reasoning, namely writing (Section 2.2) and collaborative learning (Section 2.3). Section 2.4 argues that computer-supported collaborative learning (CSCL) may provide a suitable learning environment for collaboration on a writing task, geared toward the elicitation of historical reasoning. In addition, the (possible) value of external representations as supporting tools in CSCL is discussed (Section 2.4.2).

Chapter 3 describes the methods used in the empirical studies. This particular chapter provides a more general and complete overview, than the method sections of the subsequent chapters that report on the research findings (i.e., Chapters 4, 5, and 6). After reading Chapter 3, you should be able to leaf through the method sections of the latter chapters, which provide information on methods specific to the studies reported there.

The Chapters 4, 5 and 6 present the findings of the empirical studies. These three chapters have been published as a book chapter and articles. Chapter 4 reports the results of the first study. The main aim of this study was to gain insight into the capacity of a collaborative writing task in CSCL to elicit historical reasoning, and into the influence of the inquiry question addressed on the process of historical reasoning. In addition, it provided insight into problems students faced while performing a collaborative writing task in CSCL. The outcomes of this study were used in the following studies.

Chapter 5 and 6 focus on supporting historical reasoning in CSCL through the use of external representational tools. Chapter 5 reports on a study that compared the effects of the joint construction of a graphical representation (argumentative diagram) and a more linear representation (argument list), on historical reasoning in dialogue and text writing.

The study reported in Chapter 6 compared the influence of three different representational tools. The effects of the joint construction of an argumentative diagram, a list, and a matrix were compared to one another and to a control group. The datasets of the Diagram and List condition generated in the study reported in Chapter 5 were also used for the study reported in Chapter 6. The

effects of the different representational tools on historical reasoning are examined on the level of interaction processes in the chat, the constructed products, and individual learning outcomes.

Finally, Chapter 7 presents the main outcomes of the studies and discusses some puzzling findings, leading to a revision of initial assumptions and a re-conceptualization of how historical reasoning proceeds in a CSCL environment, and suggesting the use of alternative forms of analysis. Furthermore, it discusses the limitations to the studies, provides suggestions for further research, and draws some practical implications.

CHAPTER 2 THEORETICAL FRAMEWORK

The subject of this thesis is fostering historical reasoning in Computer-Supported Collaborative Learning (CSCL), in particular through the joint construction of external representations. This theoretical framework starts with exploring what it means to learn history. In Section 2.1 historical reasoning is described as a central concept in history learning and several components of historical reasoning are distinguished and discussed. Having explored the concept of historical reasoning, two strategies to engage students in historical reasoning are described: writing and collaboration. These strategies are consecutively discussed in Sections 2.2 and 2.3. In addition, Section 2.3 also considers collaborative writing as a task that may engage students in historical reasoning. In Section 2.4 it is argued that computer technology can facilitate historical reasoning and collaborative writing. Moreover, the potential of external representational tools for supporting historical reasoning is discussed. Section 2.5 presents the conclusions of this theoretical chapter and the main research question of this thesis.

2.1 Learning history through reasoning

Traditionally, the focus of history education has been on content, and learning history mainly implied memorizing important facts and data from the (national) past. This view has changed and more emphasis is currently given to practices that characterize history as a discipline, such as historical explanation and using and evaluating historical sources. At the same time perspectives on learning and instruction have changed. Knowledge is no longer viewed as an object that needs to be transmitted from the teacher or textbook into the heads of the learners (Andriessen & Sandberg, 1999; Kanselaar, De Jong, Andriessen, & Goodyear, 2000; Stahl, Hynd, Britton, McNish, & Bosquet, 1996). Instead, the (socio-)constructive nature of knowledge has been stressed (Brown, Collins & Duguid, 1989; Duffy & Jonassen, 1992). Knowledge is considered to be subjective, and every person constructs his or her own knowledge representation by relating new experiences to prior experiences. This changing view on knowledge construction is not new in the domain of history. Knowledge of the past is by nature subjective, for it is based upon the personal interpretation of historical sources. This interpretation is guided by the historian's theory of history and his sense of the purpose of history, for instance "preserve the record" or "voicing the voiceless" (Leinhardt & McCarthy Young, 1996). Whereas "history as learning facts" can be related to the so-called "transmission model of learning" (Andriessen & Sandberg, 1999), learning as the construction of knowledge implies that students actively construct an image of the past or build a historical case (Leinhardt, Stainton, Virji, & Odoroff, 1994). This implies that students become aware of the notion that there is not one true story of the

past, that different stories can coexist, and that all stories are based upon the interpretation of often contradictory historical sources. Moreover, they learn to construct their own interpretation of the past, based on the use of historical evidence. In this way, learning facts is not merely a goal in itself; instead, students learn to reason with these facts, and in doing so give their meaning to these facts. In this way, facts can be used as a frame of reference for the interpretation of the past. Thus, from a constructivist learning perspective it is assumed that students will gain a better understanding of the past by actively constructing a representation of the past instead of memorizing facts, data or ready-made stories.

The traditional view of history learning cannot only be criticized from a learning perspective, but also from the perspective of history as a discipline. It can be argued that by presenting students with ready-made stories and agreed-on explanations, the nature of historical knowledge, and history as a science are misrepresented. The products of historians are not settled conclusions, but as Seixas (1993) puts it, “provisional and tentative arguments in an ongoing dialogue with a community of scholars” (p. 313). Lee and Ashby (2000) argue that, since many stories of the past are told, students should know something of the kind of claims made by historians and on what these claims rest. In addition, it is argued that learning to reason with historical facts is a way of empowering students for their understanding of history and social life in general (Rosa, Blanco, & Huertas, 1998). Especially in a democratic society it is important for students to learn to argue about historical issues, rather than accept or reject uncritically what is presented to them (cf. Kuhn, Winestock, & Flaton, 1994). Barton and Levstik (2004) argue that in order to become active members in a democratic society, students should learn that historical accounts are not grounded in authority (such as a textbook or teacher) but in evidence, and that they should become able to distinguish historical claims that are based on evidence from those that are not.

Although it is by now generally agreed upon that learning history is more than learning facts from the past, different terms are used to describe the aim of history education, for instance “historical literacy” (e.g., Lee, 2004; Perfetti, Britt & Georgi, 1995; Roderigo, 1994), “historical thinking” (e.g., Husbands, 1996; Spoehr & Spoehr, 1994; VanSledright & Frankes, 2000; Wineburg, 2001), “historical consciousness” (e.g., Committee History and Social Sciences, 2001, Goegebeur, Simon, De Keyser, Van Dooren, & Van Landegem, 1999; Jeismann, 1997; Von Borries, 1997), and “historical reasoning” (e.g., Kuhn et al., 1994; Leinhardt, Stainton, & Virji, 1994). The terms “historical literacy” and “historical consciousness” refer more to a general ability and attitude, whereas the terms “historical thinking” and “historical reasoning” stress the activity of the students. Others relate historical thinking and reasoning to historical consciousness or literacy. According to Perfetti et al. (1995; see also Britt, Rouet, Georgi, & Perfetti, 1994) historical literacy involves learning historical events (the story) combined with the use of articulate reasoning. In this thesis the term historical reasoning will be used to refer to the central activity in history learning. The term historical reasoning stresses the active role of learners in the process of knowledge construction. Historical reasoning refers to explicated

reasoning, in speech and writing, and it stresses the verbal nature of history (Voss & Carretero, 1998b). An important element of reasoning is the fact that it reflects a transformation of knowledge and information. Voss, Wiley, and Sandak (1999) characterize reasoning as a process in which an individual moves from a given state to a new or another state via an inference. To explain the reasoning process it is therefore necessary to determine what enables the individual to go from the given state to a new one.

Although the term historical reasoning is frequently used in the literature, it is not often described in detail. Leinhardt, Stainton, Virji, & Odoroff (1994) study historical reasoning from the perspective of instructional explanations given to students. They describe historical reasoning as “the process by which central facts (about events and structures) and concepts (themes) are arranged to build an interpretative historical case” (p. 134). This process then requires analysis, synthesis, hypothesis generation, and interpretation. Most research related to historical reasoning examines only one specific aspect, for instance the use of evidence (e.g., Rouet, Britt, Mason, & Perfetti, 1996; Wineburg, 1991a), or the explanation of historical events (e.g., Carretero, López-Manjón, & Jacott, 1997). Instead of focusing on one specific aspect, our focus is on historical reasoning in general. Reviewing literature on history learning and historical reasoning, a distinction can be made between several components of historical reasoning. These are:

1. Argumentation
2. Use of sources
3. Historical change
4. Historical explanation
5. Contextualization
6. Historical concepts

Below we will elaborate on each of these components, discuss general characteristics and important findings of empirical research, all in the light of history education. It will be argued that historical reasoning is intriguing and complex, in which a lot of different cognitive activities are involved. The components of historical reasoning will be used in the empirical studies as a framework to analyze historical reasoning in dialogue and writing, and to evaluate the supportive role of several representational tools.

2.1.1 Argumentation

Because historical accounts are based upon various kinds of sources that often contain partial and contradictory information, and because historical interpretations are not definite, assertions about the past must be supported by rational arguments. These arguments should be based upon well-evaluated evidence. Voss and Means (1991) state that the skill of argumentation is fundamental to reasoning, and that it also contributes to the learning of subject matter.

Reasoning in the domain of history can be considered to be informal reasoning. Contrary to formal reasoning, informal reasoning is related to ill-structured problems and conclusions are reached on the basis of weighing arguments and evidence. These conclusions are never definite, but only more or less probable for new evidence could alter these probabilities (Kuhn, 1991; Voss, Perkins, & Segal, 1991). Voss et al. mention three criteria for evaluating the soundness of informal reasoning. These criteria include (1) whether the reasoning providing support is acceptable or true, (2) the extent to which the reason supports the conclusion, and (3) the extent to which an individual takes into account reasons that support the contradiction of the conclusion (counter argumentation). In relation to argument-based reasoning in history, Perfetti et al. (1995) maintain that sound reasoning requires awareness that (1) arguments require evidence, (2) evidence is documented, and (3) documents are not equal in their privilege as evidence. The process of argumentation is thus closely related to the use of evidence and the use of sources.

Research has shown that, although people are able to support their claims with arguments, even from a young age onwards (Stein & Miller, 1993), weaknesses can be found in relation to taking into account counterarguments, and weighing different theories (Kuhn, 1991). Research in the domain of history shows the same pattern. For example, Pontecorvo and Girardet (1993) found that discussions between 9-year olds, who were asked to reach agreement about a historical claim, largely consisted of claims and justifications for these claims. Spoehr and Spoehr (1994) argue that taking into account counter arguments is a very difficult aspect of reasoning in the domain of history.

Differences in levels of argumentation can be related to epistemological beliefs (Kuhn, 1991; Kuhn et al., 1994). Kuhn et al. discern a progression of epistemological understanding in history. At the first level, the historians' accounts of the events are not distinguished from the events themselves. The subject focuses on statements about the events themselves and meta-statements about the accounts are rare. Two accounts are not compared but information is added to provide a more complete version. In the next level, two accounts are seen as genuinely different. Differences are attributed to the bias on the part of one of the historians. A neutral, third party is seen as capable of discerning the "truth". At the third level subjects maintain that both accounts could be right, because everyone sees things from his or her own point of view. The accounts are regarded as opinions, which reflects the level of multiplism.

To conclude, historical reasoning does not mean giving just an opinion; it is the arguments (and evidence) used to support the opinion that counts, and make an opinion valuable (Barton & Levstik, 2004; Spoehr & Spoehr, 1994). This implies an awareness of history as an interpretation of the past instead of a reflection of what really happened. Although research has shown that students are often able to present arguments in favor of a claim, difficulties arise in presenting arguments contra and in weighing different arguments.

2.1.2 *Use of sources*

Information about the past is acquired by very different historical sources, such as all kinds of written documents, images and objects. A distinction can be made between primary sources (sources from the time of the event), and secondary sources (historical accounts of the events). Information from historical sources can be used as evidence to support claims about the past. Providing insight into what counts as evidence in history and how to support claims with evidence may provide students with insight into the nature of history, and relates to the active construction of historical accounts (Lee & Ashby, 2000).

Although objects and images contain much different information about the past (Fasulo, Girardet, & Pontecorvo, 1998), in educational settings students are often confronted with written sources. These sources may be rather diverse: accounts of historians, excerpts of diaries and letters, treaties, and so on. Reasoning with textual sources has extensively been studied (e.g., Leinhardt & McCarthy Young, 1996; Perfetti et al., 1995; Stahl et al., 1996; Wineburg, 1991a, 1991b, 1994, 1998). Rouet et al. (1996) make a distinction between reasoning *about* documents and reasoning *with* documents. Reasoning *with* documents refers to the ability to use document information when executing a historical inquiry. Reasoning *about* documents refers to the activity in which a document is evaluated on the basis of the type of document it is. It is not an easy job to adequately use information from sources in historical reasoning. Historical sources often contain complementary, but also contradictory information about the past. This implies that the contents of several documents cannot be simply combined into a single representation (Rouet et al., 1996), and specific knowledge about documents and methods must be acquired to evaluate the trustworthiness of sources.

Wineburg (1994) found that historians make three types of cognitive representations when reading historical texts: of the text, of the event, and of the subtext (i.e., the text as rhetorical artifact). However, students approach historical documents in a different way than expert historians. Wineburg (1991a) compared how eight historians and eight high-school students reasoned about several primary sources. From the thinking-aloud protocols he identified three heuristics related to the study of historical documents: (1) *contextualization* (the act of situating a document in a concrete temporal and spatial context), (2) *sourcing* (the act of looking first at the source of the document before reading the body of the text), and (3) *corroboration* (the act of comparing documents with each other). He found that most differences between historians and students could be related to different belief systems. First, historians and students had different beliefs about the task. Students approached the task (“Which painting most accurately depicts what happened in Lexington?”) as if one answer was correct and they had to find out. Historians, on the other hand, opposed the question with comments like “What did actually go on?” Their end result was more a suggestion than an answer. Secondly, historians were more able in the reconstruction of the event to take into account when things happened and where. A third difference was related to beliefs about the texts, the conception of the primary documents. Whereas historians considered information about the text (who wrote, at what time, etc.) to be very

important, students focused on the information in the text. Reading texts seemed to be a process of gathering information for students, with texts serving as bearers of this information. On the other hand, historians seemed to view texts as social exchanges to be understood and puzzled about the intentions of the author and situated the text in a social context. All this means that to historians what is said is inseparable from who it says. As a consequence, historians more often made use of the sourcing heuristic. A fourth difference was found in the corroboration heuristic, or in the beliefs about the nature of historical evidence. For historians, corroboration was indispensable because every account was seen as reflecting a particular point of view. They were mainly concerned with the question how a source's bias influences the quality of the report. Students seemed to view bias as an attribute of some texts but not of others. In addition, the students also gave more importance to textbooks, whereas the experts ranked primary sources higher (cf. Rouet, Marron, Perfetti, & Favart, 1998). According to Wineburg the differences between students and historians were not so much a difference in knowledge about the subject at hand (for not all the historians were specialized in the topic at hand and some students showed more factual knowledge about the topic) as a difference in knowledge and thinking skills about historical evidence. Historians were able to reason thoughtfully about the accuracy of the documents, and were in this way able to build up an elaborate model of the event at hand. So, Wineburg's study suggests that high-school students do not spontaneously use contextualization, sourcing and corroboration heuristics when reading documents. Contrary to these outcomes, Rouet et al. (1996) found that students did apply these heuristics. Britt and Aglinskias (2002) explain these different findings by differences in the task and environment used by Rouet and Wineburg. For example, they mention that in Rouet's study students were provided with all somewhat relevant and trustworthy sources (whereas Wineburg also used historical fiction), students were forced to view the extended source before reading the document, and brief source citations were used to organize documents.

The studies mentioned above all investigated students from high school and college. The CHATA-project (Concepts of History and Teaching Approaches) studied children's changing ideas about (among other things) historical evidence between the ages of seven to fourteen (e.g., Lee & Ashby, 2000; Lee, Dickinson & Ashby, 1997, 1998; Lee & Shemilt, 2004). Based on extensive studies that included 320 students, Lee and Ashby (2000) identified six steps in students' ideas about accounts and their relation to the past, namely (1) the past as given, (2) the past as inaccessible, (3) the past as determining stories, (4) the past as reported in a more or less biased way, (5) the past as selected and organized from a viewpoint, and finally (6) the past as (re-)constructed in answer to questions in accordance with criteria. Students often treated the sources as information and only used that information which supported the claim. Information from the sources was not critically discussed nor compared to information from other sources (Ashby, 2004). These outcomes are in line with the results found by Wineburg.

It can thus be concluded that students have difficulties with reasoning about documents, and that they do not tend to apply sourcing, contextualization, and corroboration heuristics. However, it seems that it is not so much that students are not able to do this, but more that they do not spontaneously do it. Characteristics of the task seem to be an important factor in applying these heuristics.

2.1.3 Historical change

In history, the argumentative process often aims at the interpretation and/or the explanation of historical changes. According to Stearns (1998) the main purpose of history is to understand the phenomenon of change over time. He argues that historical change is a multifaceted subject. It can occur in very different areas of society, for instance political systems, technologies, fundamental beliefs and family life. Historians often make a distinction between political, economical, social and cultural changes. Studying historical changes raises not only the question of what has changed, but also of what has stayed the same and what has caused the change. Focus on continuity helps to interpret the historical change: to see what the impact of the change is and how the change came about, for example suddenly, gradually or more in the long term.

Although the aspect of change and continuity is central in the study of history, it has hardly been investigated how students identify and describe historical change and continuity. An exception is formed by Barton (Barton, 2001; Barton & Levstik, 2004). In several interesting studies, carried out both in the United States and in Northern Ireland, he examined children's understanding of change over time. He found that the children of these countries differed in their explanations of how and why social and material life has changed. Children in the U.S. encounter the past in the context of a narrative of national development and progress, grounded in individual achievement. When asked to chronologically order photographs, they placed a photograph of immigrants before a photograph of a city, whereas the photograph of the city represented earlier times. In their explanations they pointed to the more developed and settled nature of the city; first people lived in places with grass and fields, and only later cities were built. So, the students ordered pictures according to their belief that historical development occurred in a simple and progressive sequence. They failed to recognize that different pictures could come from the same time, that they can represent different places (country versus city), or different classes of people (rich versus poor). The students from Northern Ireland, on the other hand, showed more awareness that change does not occur simultaneously throughout society. Moreover, they showed a much greater tendency to describe change in terms of societal institutions and group processes, contrary to the students in the U.S. who described change in terms of individual achievement. The latter also described historical change as a straightforward, linear line of progression, instead of a random, ambiguous or cyclical process. Barton explains these differences from a socio-cultural perspective and refers to the differences in the social-cultural environment and related differences in the representation of history. Children in Northern Ireland are less likely, for

both political and pedagogical reasons, to encounter the kinds of national narratives common in the U.S. (such as the narrative of national progress). History education in Northern Ireland is more analytical, and focuses on static portrayals of societies at different times rather than on an overarching narrative.

From this study it can be concluded that ideas about history and historical change are shaped by the cultural contexts in which they arise and that the representation of historical information both influences and limits historical thinking.

2.1.4 Historical explanation

Explaining the past is an important element of historical reasoning, and it has received most attention in research into history learning. It is often stressed that causation in history does not involve simple cause-effect relationships. Instead, there are many actions and events that occur over time that could play a role in producing historical events. A distinction can be made between immediate and long-term causes, and between manifest and latent events, i.e., long-term developments, such as population shift or climate change (Spoehr & Spoehr, 1994). Jacott, López-Manjón, and Carretero (1998) mention two different theoretical models of explanation in history. The intentionalist model conceptualizes historical explanation basically in terms of human actions, attributing a great importance to the particular motives, intentions and beliefs of the agents involved. The structural model of explanation is based on the relationship between a set of conditions (e.g., economic, demographic, social, political, religious) that constitute social reality. Thus, in the case of explaining, historians search for more than one (type of) cause.

Results from several studies show that students tend to explain historical events from the intentionalist, personalistic point of view (e.g., Carretero, Jacott, Limón, López-Manjón, & León, 1994; Carretero et al., 1997; Halldén, 1993). In a study conducted by Carretero et al. (1997) novice and experts were asked to explain four historical events by ranking six different types of causes in order of importance (political, economic, ideological, personalistic, remote, and international policy). The results showed that non-experts attributed greater importance to personalistic causes. This is in line with findings of Rivière, Nunez, Barquero, and Fontela (1998) that show that personal factors are better recalled, especially in lower levels of education. Experts tend to vary the importance given to different causes according to the historical event in question. They do not attribute the same influence to political, economic and cultural-ideological causes, but consider each event in its own context.

Thus, while explaining the past, students face difficulties in using multiple and different types of causes. They tend to maximize the role of human action and give less importance to institutional factors.

2.1.5 *Contextualization*

In order to interpret and explain historical events, one has to apply a wide range of general knowledge of how social variables function, and interrelate these in order to interpret the specific events under consideration (Kuhn et al., 1994). But also knowledge of the specific historical context (which is formed by the characteristics of the time and place of the event) is needed to understand and interpret historical events and acts of persons. One has to find the appropriate historical context and then interpret the phenomenon in accordance with that context (Halldén, 1997). This requires the ability to imagine oneself in situations one is not likely to experience (Spoehr & Spoehr, 1994). This ability is also referred to with the term empathy (Lee et al., 1997).

De Keyser and Vandepitte (1998) distinguish different frames of reference that can be used to contextualize a historical phenomenon: a chronological frame of reference (knowledge of periods, significant events, and developments), a spatial frame of reference (knowledge about locations and scale) and a social frame of reference (components of human behavior and social activity, such as socio-economic, socio-political, and socio-cultural conditions of life). Especially the chronological frame is fundamental in history, for it is its main organizing principle. However, chronological understanding is also highly complex, comprising a variety of areas of notions, including mathematical, linguistic, and logical (Stow & Haydn, 2000). Moreover, a variety of different concepts is used to describe time: century, decade, before the French Revolution, Middle Ages, Roman period, before Christ, etcetera. Stow and Haydn (2000) point out that chronology in history education does not only refer to the sequencing of events, but also to a general understanding of historical time, such as dating systems, and time-related vocabulary. Surprisingly, this aspect received little attention in research (Carretero et al., 1994; Van Boxtel & Van Drie, 2004).

Based on the study of how expert historians interpret historical texts Wineburg (1998) identified six categories of statements that reflect contextualization. These categories include spatio-temporal, social-rhetorical, biographic, historiographic, linguistic, and analogical comments. Contextualization requires extensive and detailed knowledge that is often lacking (Wineburg, 2001). Wineburg and Fournier (1994) found that even teachers-in-training either failed to create a context for historical events or selected a contemporary context (presentism). Van Boxtel and Van Drie (2004) compared how experts and novices situated historical sources in time. They found that both experts and novices used a chronological-spatial frame of reference while situating historical sources in time. However, this frame of reference was more detailed for the experts. In the situation that the frame of reference of the novices fell short, they relied on a more general schema of historical development as progression. Although factual knowledge is an important element in creating a historical context, Wineburg (1998) found some other critical elements in expertise: the ability to identify one's knowledge gaps, to formulate questions, and to mark information or conclusions as questionable.

The failure to grasp the nature of historical context is an important source of student misunderstanding (Husbands, 1996; Wineburg, 1991a, 2001). Students often find it difficult to try and

think about the past in its own terms and not to judge past actors and actions solely by present standards. Based on their studies, Lee et al. (1997) present a model of progression for rational understanding in history, in which contextualization and empathy are important aspects. The lowest level is what they call “The ‘Divi’ Past”: past action is unintelligible because people in the past were “divi”: stupid, not as clever as we are, inept, morally defective, or “did not know any better”. Students in a more advanced level began to view history as an explanatory system but made little attempt to understand the past in its own terms. At the highest level, called “Contextual historical empathy”, actions of people in the past are set in a wider context of beliefs and values. It is recognized that there are differences between past and present mind sets. According to Lee et al., only from the age of 11 to 14 some students are beginning to distinguish between what they know about the situation from what the historical agent knew at that time.

2.1.6 *Historical concepts*

Each domain has its own language. Discipline-bound concepts are “tools” to think about, question, describe, analyze, synthesize, and discuss historical phenomena. A distinction can be made between methodological and substantive concepts. Substantive concepts refer to historical phenomena, structures, persons, and periods (for example pharaoh, feudalism, Charles V, and Enlightenment). Methodological or second order concepts (Lee et al., 1998) or meta-concepts (Limón, 2002) are related to the methods used by historians to investigate and describe historical processes and periods, such as cause, consequence, change, continuity, and reliability of sources. These concepts are thus related to the various components of historical reasoning described above. They can be considered to be a kind of grammar of history, for they have the power to organize the infinite number of facts that characterize history (Husbands, 1996). Limón argues that these meta-concepts form the basis of historical knowledge and mediate students’ understanding of substantive concepts. However, students’ knowledge about these concepts is often implicit (Lee et al., 1998). Voss, Wiley, and Kennet (1998) found that college students did not have an overall coherent view of historical concepts. Although they did seem to have some understanding of methodological concepts, this understanding is not well integrated.

Students face various problems in understanding and using substantive concepts (Van Drie & Van Boxtel, 2003). First, historical concepts are often abstract and theoretical. They do not refer to concrete objects in the past and are given meaning in the context of related concepts. For example, to explain the concept “democracy” other concepts must be used, for instance “parliament”, “representation”, and “government”. Each of these concepts is abstract and difficult to understand. A second problem is that substantive concepts often have no fixed meaning. The discipline of history does not have a large specialized lexicon, and uses concepts taken from other disciplines (such as economics, politics, and sociology), and from everyday life (Berti, 1994). Concepts used in everyday life often have a different meaning in the past. For example, trade meant something different in the

Middle Ages than in our present Western society. Thus, the meaning of the concept can differ in time and place and students must learn to describe phenomena that are different from those experienced in the present with known terms. Students often interpret a concept on the basis of their knowledge of the present time and therefore misunderstanding or misconceptions through anachronism can easily develop. Students must differentiate between the present meaning of concepts and the meaning of concepts used in a specific historical context. Moreover, some concepts, such as fascism or slavery, give rise to strong feelings. This makes distinguishing between moral judgment and historical explanation difficult (Von Borries, 1994). Moreover, historians themselves differ in their interpretation of concepts (Ankersmit, 1982). A third problem arises from the fact that some concepts are very specific and limited to one period. So, students may come across them only a limited number of times, and have only limited opportunity to understand and learn these concepts (Berti, 1994). Limón (2002) adds that historical concepts are often implicit and not presented in an isolated way, but within a narrative. Therefore, students often have to infer their meaning. This can be considered to be a fourth problem.

Relatively little research has been conducted into students' ideas on particular substantive concepts (Limón, 2002). The studies that did focus on students' concept knowledge found that this knowledge is limited. Berti (1994) for example notes that students' use of concepts does not guarantee the correct understanding of their meaning. McKeown and Beck (1990) studied young students' knowledge about the American Revolution just before and a year after they studied the subject in schools. They found that students in both groups were only able to provide simple associations with the concepts and simple links among ideas. Moreover, there were a lot of misconceptions and confusions. Others have shown that conceptual understanding in history is related to one's social experience and culture (Delval, 1994; Torney-Purta, 1994). Especially younger children may have difficulty in understanding these concepts, since they have limited social experience.

2.1.7 Conclusions

Historical reasoning can be considered to be an important activity for history learning. Learning history implies learning to reason with the facts from the past and to build historical accounts based on historical evidence. Historical reasoning has been described as comprising several activities including: (1) argumentation, (2) use of sources, (3) historical change, (4) historical explanation, (5) contextualization, and (6) use of historical concepts. It should be noted that in our view it is not necessary for all components to be present in order to speak of historical reasoning. Which components are used as well as the importance of each of these components depends on the complexity and level of the historical problem or question addressed, the information and means that are available, and the product asked for. For example, students can be asked to explain the outbreak of the Vietnam war after studying a part of a text book. In this case, less emphasis is given to the use of sources and to historical change. Moreover, it is important to keep in mind that historical reasoning is

described here from an educational perspective, thus focusing on how students reason historically in school settings. Of course, historical reasoning also occurs in the setting of professional historians and in everyday situations, for instance while reading the newspaper (cf. Mosborg, 2002).

Historical reasoning, as described above, is quite a complex activity (cf. Fernández-Corte, & García-Madruga, 1998; Lowenthal, 2000; Shemilt, 2000; Spoehr & Spoehr, 1994). Wineburg (2001) even describes historical thinking as an “unnatural act”. Most research on learning history has been conducted on the level of high-school and university students, which has consequences for what might be expected of the students. Still, it can be concluded that historical reasoning contains several problematic aspects. First, students tend to only use arguments supporting their own point of view and do not take into account alternative views. Also weighing different arguments is considered to be difficult. A second, related problem is that students show less tendency to use sources and corroboration when studying historical documents. A third problem relates to the contextualization of historical problems. This not only requires detailed factual knowledge of the issue at hand, but also knowledge of how people and societies function. Fourth, it is difficult to judge the past by its own standards, and not by our present ones. Fifthly, in describing historical changes students often find it difficult to take into account processes of continuity. Sixthly, students face problems in using multiple and different types of causes while explaining the past. In explaining the past, students tend to maximize the role of human action, and minimize the role of institutional factors. And finally, many historical concepts are difficult for students to understand and use in a correct way. Individual differences in historical reasoning can be related to various aspects, for instance age and development (e.g., Kuhn et al., 1994; Torney-Purta, 1994), culture (e.g., Barton, 2001; Delval, 1994), the working memory capacity (e.g., Fernández-Corte & García-Madruga, 1998), and epistemological beliefs (e.g., Kuhn et al., 1994; Voss et al., 1998). Moreover, specific content knowledge plays an important role (e.g., Leinhardt & McCarthy Young, 1996; Perfetti, et al., 1995; Wineburg 1998).

From an educational perspective an important question is how to engage and promote students’ historical reasoning. Leinhardt has shown that historical reasoning can be promoted by teacher-student conversations (Leinhardt, 1993, 1997) and by writing tasks (Leinhardt, 2000; McCarthy Young & Leinhardt, 1998). In the present thesis, collaborative learning is proposed as a third instructional strategy for promoting historical reasoning. The focus of this thesis is on two of these strategies, namely writing and collaborative learning. More specifically, it is investigated whether and how historical reasoning can be facilitated and promoted by a collaborative writing task in an environment for computer-supported collaborative learning. In addition, the supporting role of external representations is investigated. The next sections will describe the potential of writing, collaboration, and computer-supported collaborative learning for promoting historical reasoning, consecutively.

2.2 Writing and historical reasoning

In the section above historical reasoning was described as an important aspect of history learning. In this section, it is argued that writing tasks may enhance historical reasoning. Writing an argumentative text based upon the study of multiple sources is especially assumed to be useful task. First, it is described how in general writing may function as a tool for thinking and learning. Next, characteristics of writing in the domain of history are explored.

2.2.1 *Writing as a tool for thinking and learning*

Writing can be considered to be a means to engage students in historical reasoning (Counsell, 1997; Greene, 1994; McCarthy Young & Leinhardt, 1998; Voss et al., 1991). In (history) education students are engaged in many writing activities, such as note-taking, short-answer questions, and essay writing. However, writing in the classroom is often used for limited purposes, primarily to monitor and evaluate what students have already learned. This view of writing is in line with the view of learning as transmission of knowledge: writing reveals what the “black box” contains. Recent cognitive and constructivist approaches view writing as a tool for thinking and domain-content learning (Tynjälä, Mason, & Lonka, 2001). In this writing-to-learn approach, it is argued that during writing students are actively engaged in the subject and explore relations among ideas, and that writing may thus contribute to constructing new knowledge, developing deep understanding, fostering conceptual change, and developing thinking skills (Klein, 1999; Tynjälä et al., 2001). Analytic writing especially seems to enhance reasoning and learning (Ackerman, 1993; Langer, 1986).

Although research on writing-to-learn is often conducted in the field of science, some positive effects have also been found in the field of history (e.g., Boscolo & Mason, 2001; Voss & Wiley, 1997). Boscolo and Mason conducted a study in which they compared a writing group with a non-writing group in elementary schools. The results indicated that those in the pupils in the writing group developed a deeper understanding of the historical topic than the non-writing group. Improvement was found in conceptual understanding and the explanations of the historical event. The authors also found a change in pupils’ beliefs of the nature of history and the role of historians. Pupils in the writing group were better able to recognize the differences between two historical accounts of an certain event.

In what way may writing improve the learning of subject-matter content? According to Bangert-Drowns, Hurley, and Wilkinson (2004) writing can support students’ use of different cognitive learning strategies, for example rehearsal strategies, elaboration and organization strategies and comprehension-monitoring strategies. They conclude from the findings of their meta-analysis of 48 writing-to-learn programs that especially these meta-cognitive comprehension-monitoring prompts are related to positive effects on learning. In a review study Klein (1999) distinguishes four hypotheses about how writing can contribute to learning. The first hypothesis, *shaping at the point of utterance* (or

spontaneous idea generation), suggests that writers generate knowledge by generating language into text. By converting tacit knowledge into explicit knowledge, writers may become more aware of their thinking. In this hypothesis the process of spontaneous writing is considered to be important for learning, more so than processes such as planning or revision. The second hypothesis is called *forward search hypothesis*. It assumes that writers first externalize their ideas in text, which allows them to reread them and develop them further. By rereading their text, ideas are transformed by processes such as making new inferences and detecting contradictions. The third hypothesis, the *genre hypothesis*, focuses on the structure of the text rather than on the process of composing text. Writers use genre structures to organize relationships among elements of the text, thereby linking elements of knowledge. It assumes that different genres require different cognitive processes and may result in different kinds of learning. The last hypothesis, the *backward search hypothesis*, assumes that rhetorical and content-related problems interact. Writers construct knowledge by first setting rhetorical goals, then generate content to address these goals, and finally revise their rhetorical goals to accommodate this content.

Since this last hypothesis is considered to be important for our studies, two important examples of the backward search hypothesis will be discussed. These are the problem-solving models of Hayes and Flower (1980) and of Bereiter and Scardamalia (1987). In both models, writing is viewed as a controlled and recursive process to reach the goals one wants to achieve with the text (Galbraith & Torrance, 1999). Hayes and Flower defined effective writing as a matter of finding the solution to rhetorical problems, and consequently described writing as problem-solving. They discerned three main processes involved in writing: 1) *planning*, which includes generating ideas, organizing and setting goals; 2) *translating* domain knowledge into language under the control of the writing plan; 3) *reviewing* the text, in which the text is evaluated by means of the goals; this involves reading the text and possibly correcting or editing it. These three processes are managed by a control process, *monitoring*, and operate upon two kinds of information; (1) the *task environment*, which consists of the writing assignment (topic, goal, instructions) and the text produced so far, and (2) the writers' *long-term memory*, which contains topic knowledge, knowledge of the audience, and linguistic knowledge about text plans and grammar rules. Experts in writing are able to construct a more sophisticated representation of their goals and develop and modify this representation throughout the process of writing. This enables them to revise more extensively, and to evaluate their texts on the basis of their goals. Moreover, the process of generating goals and organizing knowledge to satisfy these goals can lead to the discovery and generation of new ideas.

Bereiter and Scardamalia (1987) also view writing as a problem-solving activity. They proposed a developmental model of writing, in which they described two writing strategies, as two extremes on a continuum. The *knowledge telling* strategy is a strategy employed by novice writers. Based on the mental representation of the assignment and using its content and discourse knowledge, the writer directly translates this into text. The *knowledge transforming* strategy, employed by expert

writers, also involves knowledge telling, but this is now embedded in a problem-solving process. This problem-solving process involves two different kinds of problem spaces. In the content space, problems of belief and knowledge are worked out. In the rhetorical space, problems of achieving goals of the composition are dealt with. These two operate in close interaction. Content knowledge and discourse knowledge are not translated directly, as in the knowledge telling strategy, but rather transformed in such a way that all rhetorical and content constraints of the writing task are taken into account. This process of transforming goes beyond restructuring of existing knowledge to generate new knowledge.

Although these models are very important and have provided us with much more insight into writing, the models have also been criticized. For instance, the model of Hayes and Flower does not specify what could be the effects of the writing medium (paper and pen vs. computer) on the writing process and it is only concerned with the writer working alone. It ignores inter-individual differences and writer creativity (Alamargot & Chanquoy, 2001). Klein (1999) argues that although research has shown that expert writers use the strategies described by the models of Flower and Hayes and of Bereiter and Scardamalia, it still is not clear whether these strategies actually contribute to discovery or knowledge transformation. For example, Galbraith (1999) argues that the problem-solving models fail to capture the role writing has in constituting thought. He suggests that because problem solving operates on ideas once they have been formed, it can only lead to the reorganization of existing content and not to development of new understanding. However, writing can also be seen as a spontaneous process of generating thoughts and constructing meaning. This may take place without any reflection or revision (cf. the spontaneous idea generation hypothesis).

To conclude, there are several hypotheses about how writing may contribute to learning, and each stresses different processes: spontaneous generation of ideas; revision of the initial draft; influence of the genre in organizing the information; and generation and revision of content to address rhetorical goals. Klein (1999) pointed out that only the genre hypothesis has been systematically tested so far and has resulted in generally positive effects on writers' learning. Still, it must be noted that writing does not necessarily enhance thinking or learning, as studies on writing-to-learn show both positive and negative outcomes (Ackerman, 1993; Bangert-Drowns et al., 2004; Klein, 1999). Recently, Bangert-Drowns et al. conducted a meta-analysis on the effects of school-based writing-to-learn interventions on academic achievement. Based on the analyses of 48 studies they concluded that writing-to-learn did produce small positive effects on learning subject matter. Moreover, the effects of writing on learning were mediated by contextual factors. Enhanced effects were related to the use of meta-cognitive prompts and to increased treatment length, whereas implementation in grades 6 to 8 and longer writing assignments predicted reduced effects. The role of contextual factors in writing-to-learn is also highlighted by Tynjälä et al. (2001). They maintain that it is important that writing-to-learn tasks are embedded in social interaction and classroom discussion, for instance through collaborative writing activities requiring students to build a shared understanding of the topic at hand.

This is in line with a socio-constructivist perspective of learning, in which the importance of social interaction for writing is stressed and in which the participation in the cultural discourse practice is considered to be important (Tynjälä et al., 2001). In Section 2.3.2 this line of reasoning will be continued when the role of collaborative writing will be discussed. First, writing in the field of history will be described in more detail.

2.2.2 Writing in the field of history

Writing can be considered to be a central way of clarifying ideas about the past, not only for historians, but also in the classroom (Husbands, 1996). An important characteristic of writing in the domain of history is that it is often based on the study of multiple documents. Document-based writing can be described as a process by which writers transform source texts to compose new texts by actively selecting information, organizing information and connecting information (Rouet et al., 1996). However, writers in history cannot simply combine information of several sources into a single representation. Text comprehension is often described by the model of Van Dijk and Kintsch (1983). From this model text comprehension is understood as the building of a “situation model”, which means the integration of text information and the reader’s previous knowledge. Rouet et al. (1998) argue that in the case of history one model will not suffice. Historical documents each give only a partial account of the situation they describe and they often provide contradicting information. Moreover, historical documents reflect a specific perspective of the situation. It is therefore necessary to take into account the characteristics and the context of the source, to check the information and compare it with other documents, and finally to decide which information should be selected and used. In order to understand a historical issue on the basis of multiple documents, one first has to understand the single text and build a situation model of that text. Next, an additional level of representation must be built including the characteristics of the documents, the different perspectives reflected in the documents and the comparison between the documents. Rouet et al. (1998) refer to this as the “argument model”. This argument model integrates argumentative relations between documents, allows contradictory statements to be maintained in a coherent representation and may serve as a retrieval structure. Thus, writing in history implies more than summarizing the sequence of events in each document. It also involves coordinating representations of several texts, resolving inconsistencies, and evaluating and weighing the information of the text. In Section 2.2.1 it was pointed out that writing may enhance historical reasoning. When writing in history is considered to be building a situation model as well as an argument model, the importance of the different components of historical reasoning described in Section 2.1 becomes clear. Writing in history then implies the use of arguments, the use and evaluation of historical sources, contextualization, and the use of substantive and historical concepts. The importance of the components “historical change” and “explanation” of course depends on the issue at hand.

Research has indicated that writing tasks based on the study of multiple documents are suitable tasks to promote historical understanding and to engage students in historical reasoning (e.g., Perfetti et al., 1995; Rouet et al., 1996; Wiley & Voss, 1996, 1999). Perfetti et al. (1995) investigated text-based learning and reasoning in history. Six undergraduate students participated in a short course in which they studied issues of the Panama Canal. For each of the eight meetings with the experimenters, they were asked to study a document on their own and be prepared to answer questions about it. During the meetings they wrote summaries and answered a scripted set of comprehension and reasoning questions. It can be concluded from this study, that students initially learned the basic narrative and then gradually elaborated upon it. Moreover, as their knowledge about events and details accumulated, students engaged in more complex reasoning. They gave more supporting reasons for their claims and more qualifiers and used longer causal chains. McCarthy Young and Leinhardt (1998) also provided evidence for this claim. In their study they followed the developments of five students in document-based historical text writing over a school year, guided and provided with feedback by a teacher. Detailed analyses of the content and rhetorical quality of their texts indicated that the students improved in both areas. They described this progression by using Bereiter and Scardamalia's model of knowledge telling and knowledge transforming (1987; see also Section 2.2.1). They conclude that the students moved from knowledge telling, in which period and document knowledge were listed as discrete bits of information, to knowledge transforming, in which students interpreted and integrated period and document knowledge as evidence for their claims. Over the year, the texts showed increasingly elaborated theses, factor-specified list patterns, source contextualization and increased structural complexity. However, on the other hand, students still faced difficulties in using rhetorical strategies to integrate historical facts into explanations and arguments.

Voss and Wiley (1997) found that writing an argumentative essay in combination with multiple sources especially enhances learning and understanding in history, as it engages students in knowledge transforming activities. They conducted a study in which they compared how sources and writing task affected students' learning and understanding in history. Sixty undergraduates were given either a textbook chapter about the Irish potato famine between 1800 and 1850 or the same information in the form of multiple sources. After reading, they were instructed to write a history, a narrative or an argumentative essay about what produced the significant changes in Ireland's population between 1846 and 1850. The researchers hypothesized that learning from sources would yield higher performance than learning from a textbook, because it requires more processing to integrate source material than to integrate the material in the already organized textbook. Writing an argumentative essay would also require more processing, as it requires examining and evaluating several factors and organizing them into a reasonable argument. The findings showed that the multiple source/argumentative essay condition resulted in more transformation of information and more analytic essays, with more causal and connective statements than the other conditions. Moreover, it produced better understanding of the relations among concepts and resulted in better learning (recall)

of text content (although this was also found for the textbook/narrative condition). On the basis of these and additional results, Wiley and Voss (1999) suggest that the combination of multiple sources and argumentative writing in particular provides a learning context that promotes constructive and transforming activities and better understanding in history. These findings also provide additional support for the “genre hypothesis” mentioned in Section 2.2.1. Different types of writing tasks require different cognitive processes and hence result in different kinds of learning and reasoning.

To conclude, writing in history is often based on the study of multiple sources and can be described as building a situation model and an argument model. Research has indicated that argumentative writing based upon multiple documents may enhance historical reasoning and learning. It requires important activities of historical reasoning, for example the use and evaluation of sources, contextualization, and argumentation. Still, it should be acknowledged that document-based argumentative writing is a complex task, since it not only requires building a representation of the topic based on different single representations, but also organizing and structuring this into an argumentative structure. Building an argumentative structure implies generating and ordering arguments based on one’s position, and in such a way that it will convince the reader. It requires both knowledge of the content of the domain and knowledge of its rhetorical processes (McCarthy Young & Leinhardt, 1998). Students may face various problems while writing argumentative texts in history. These problems do not only relate to the process of historical reasoning, such as using sourcing heuristics (cf. Britt & Aglinskis, 2002; Wineburg, 1991a, 1991b), but also to the organization of ideas and arguments and to the ordering of content into a linear sequence of information (Coirier, Andriessen, & Chanquoy, 1999). The question arises how to support students to overcome these problems. According to Klein (1999) studies in writing-to-learn have neglected to investigate how to support students while writing. In the present thesis the (possible) supporting role of the construction of external representations is investigated.

2.3 Collaboration and historical reasoning

As is shown in the section above, writing can be assumed to enhance historical reasoning. Especially, it is assumed that the writing of argumentative texts on the basis of multiple sources may be a suitable task to foster historical reasoning. In this section a second (and complementary) approach to engage students in historical reasoning is presented: collaboration. It is argued that collaborative learning tasks may elicit interaction processes that enhance historical reasoning and the learning of history. Section 2.3.1 describes interaction processes that may contribute to learning history. Next, Section 2.3.2 focuses in particular on collaborative writing.

2.3.1 *Interaction processes that contribute to learning history*

Reasoning can be considered to be a form of social practice and therefore dialogical (Wegerif, Mercer, & Dawes, 1999). In dialogue with peers, students have to make explicit their thoughts and ideas. This thinking aloud is considered to be a way of meaning making in itself (King, 1999). Moreover, when thinking is made explicit it is open to questioning and discussion. Research conducted by Kuhn, Shaw, and Felton (1997) showed that dyadic discussions enhanced the quality of reasoning. Not only did the range of different arguments increase from pretest to post-test, but the participants (early adolescence and young adulthood) also included alternative views and arguments in their reasoning and became more aware of the existence of multiple views. Kuhn et al. subscribe these changes primarily to being engaged in peer discussions. Pontecorvo and Girardet (1993) showed that collaborative learning can elicit and promote historical reasoning. Pupils (9 years of age) were asked to reach agreement in a group about a historical claim. Pontecorvo and Girardet reported that the discussions reflected high-level historical reasoning. Collaborative learning may thus be a suitable strategy to engage students in historical reasoning.

By collaboration we refer to the situation in which two or more students work together on a collective task in which they share both tools and activities and for which they all share responsibility (Erkens, 1997; Webb & Palincsar, 1996). Research has shown that collaborative learning may have positive effects on the cognitive level, but also on the social and motivational level (Roelofs, Van der Linden, & Erkens, 2000). Still, collaborative learning not always results in positive learning outcomes (Dillenbough, 1999; Mercer, 1996; Roelofs et al., 2000; Van der Linden, Erkens, Schmidt & Renshaw, 2000). Research on collaborative learning has indicated that meaningful learning is related to the quality of the interaction (Van der Linden et al., 2000). The design of the task and the available tools are important factors affecting the quality of the student interaction (O'Donnell, 1999; Van Boxtel, 2000). Still, more needs to be known about the complex relation between the characteristics of the learning environment and task, the interaction processes and the intended learning outcomes (Roelofs et al., 2000). Below, the focus will first be on interaction processes contributing to learning, and in the next section on the task, in particular on collaborative writing tasks in history.

What kind of interaction processes can be considered to be important for learning in general and learning in history in particular? Van Boxtel (2004) discerns three perspectives from which peer interaction can be studied: an elaboration perspective, a co-construction perspective, and a domain-specific perspective. First, from the elaboration perspective it is believed that peer interaction stimulates the elaboration of knowledge (O'Donnell & King, 1999). Elaboration takes place when students create new relations by giving examples, using analogies, reformulating, and referring to school or everyday experiences (Van Boxtel, 2004). Teasley (1995) suggests that while working with others, knowledge becomes more elaborate, for students have to explicitly verbalize their thoughts, opinions and arguments. In the confrontation with their partner's thoughts, this may result in elaborative reasoning through discussion, negotiation and questioning. In addition, verbalizing can

make students become more aware of their own thinking, of possible knowledge gaps, and lack of understanding (Brown & Champione, 1986). Empirical support for this hypothesis is for example found by Teasley (1995), who found that students working in dyads generated more elaborative utterances than students who worked individually and were asked to think aloud. In addition, Van Boxtel, Van der Linden, and Kanselaar (2000b) found in a study on collaborative physics learning that more elaboration in peer interaction correlated with higher scores on the individual post-test. Van Boxtel (2004) points out that elaboration can be reflected (1) through individual or collaborative reasoning episodes in which students make logical extensions of what is previously said, (2) through question-answer episodes that include elaborate answers (cf. King, 1990; Webb, 1989, 1991), and (3) through conflict episodes in which a statement is explained or justified and in which students try to resolve the conflict through argumentation (cf. Brown & Palinscar, 1989; Doise & Mugny, 1984).

Secondly, effects of collaboration are explained from the co-construction perspective in the way collaborative partners can reach and sustain a common frame of reference through communication and the use of mediational tools. This perspective is based on socio-cultural ideas of learning. Whereas the socio-constructivist perspective highlights the effects of interaction processes for individual learning through elaboration, the socio-cultural view regards individuals' learning as inherently involved with the socio-cultural activities in which they are engaged (Rogoff, 1998). Socio-cultural theories consider cognitive development to be a cultural process in which knowledge is not only possessed by the individual, but also shared amongst members of communities. In order to understand the nature of thinking and learning the intrinsically social and communicative nature of life as well as the cultural and historical setting should be taken into account (Rojas-Drummond & Mercer, 2003; Wertsch, 1991). Language can be seen as both a cultural (for the development and sharing of knowledge amongst members of a community) and a psychological tool (for structuring the processes and content of individual thought). They emphasize the role of social interaction in the construction of knowledge, originally with an adult or more competent peer, later on also between peers (Kumpulainen, 1996). Interaction or inter-mental processes are seen as giving rise to individual processes or intra-mental processes, generating new understandings and ways of thinking. In this respect, Mercer (1996) describes talk as a social mode of thinking for it is not only a means to share thoughts but also a tool for the joint construction of thinking. Mercer maintains that this may especially occur when collaborative partners are critically but constructively engaged with each others' ideas (Mercer, 1996; Rojas-Drummond & Mercer, 2003). Roschelle (1992) points out that when peers work on a collaborative task mutual understanding must be created and sustained. According to Erkens (2004) this can be achieved through processes such as tuning (adapting to the level of understanding of the partner), checking (checking exchanged information in relation to the existing knowledge structure) and focusing (mutual control of focus and topic of discussion). An important question, however, is whether knowledge is really shared and co-constructed. Student interactions can differ from each other in the degree of co-construction. Sometimes one of the

participants does almost all of the talking and work, while others remain passive. Kumpulainen and Mutanen (1999) distinguish between three modes of co-construction: individualistic, dominative and collaborative reasoning. In the first two of these students are not really collaborating and sharing knowledge; they work rather individually or, in the dominative mode, one student dominates the other. In the collaborative mode students (more or less) contribute equally to the reasoning and build upon each other's contributions by questioning and giving examples or arguments. Interaction in which one of the students is dominating or which shows unproductive dispute or the accumulation of ideas without critical challenges is believed to be less valuable for learning (Mercer, 1995). Thus, whereas the focus is on whether the reasoning episode is elaborated, and extended, and contains explanations, arguments, relations, analogies etcetera from the elaboration perspective, the co-construction perspective emphasizes the extent of participation and collaboration between students while reasoning.

Thirdly, from the domain-specific perspective the main focus is on the content of the student interaction. It is not only important to consider *how* learners interact with each other (whether or not in an elaborate and co-constructed way), but also *what* this interaction is about. From this perspective an important question is whether students make progress from their everyday reasoning towards a deeper understanding and more scientific way of reasoning in the domain at hand. Types of talk that are of interest are the explication of one's own conceptions, the comparison of these conceptions with new information and interpretations of others, and the search for meaningful relations. In the case of the history domain, the components of historical reasoning mentioned in Section 2.1 can be used as a framework to examine peer interaction from a domain-specific perspective.

Van Boxtel (2004) points out that dialogues combining the processes described by the three perspectives can be especially meaningful to learning, i.e., interaction processes reflecting elaborated domain-specific reasoning, co-constructed by two or more learners. Evidence for this assumption can be found in a study conducted by Van Boxtel, Van der Linden and Kanselaar (2000a) on collaborative concept learning in physics. It was found that collaborative elaboration correlated positively with individual learning outcomes. Other researchers have also stressed the importance of interaction characterized as both elaborated and co-constructed (e.g., Baker, 1999; Mercer, 1996). Mercer, for example, refers to this by the term "exploratory talk". Exploratory talk refers to the type of talk that occurs when students are critically but constructively engaged in each other's ideas and reason together. These ideas are explicitly presented and become shared, jointly evaluated and eventually agreement is sought as a basis for joint progress. Mercer found that groups who used more exploratory talk were more successful in solving the problem presented in the task. Moreover, the students who participated in a program on learning the ground rules of exploratory talk performed better on an individual post-test and improved their individual reasoning skills, compared to the group who had not participated in this program.

To conclude, it is assumed that interaction episodes that reflect elaborate historical reasoning which is co-constructed by two (or more) students, may contribute to learning. In this thesis, the term *co-elaborated historical reasoning* will be used to refer to this kind of interaction.

2.3.2 Collaborative writing

Thus far, two means to enhance learning and reasoning in the domain of history have been identified: writing and collaboration. Moreover, it was argued that the task and the available tools are important factors affecting the quality of the student interaction. This raises the question whether a collaborative writing task might be a meaningful task in the sense that it elicits co-elaborated and domain-specific reasoning. When talking of collaborative writing, it is important to consider the degree of collaboration on a writing task, for this can vary. For instance, students can collaborate during the planning of the text or give feedback on the first draft (cf. Gere & Stevens, 1989). The most extensive form of collaboration is co-authoring, in which a group shares responsibility for the construction and writing of a text. The term collaborative writing will be used interchangeably for co-authoring. Research indicated that collaborative writing can have a positive effect on students' writing. O'Donnell et al. (1985) found that students who had co-authored a text, wrote more communicatively and clearly, both in their co-authored text as in subsequent individual writing, than those who wrote alone. In a collaborative writing context Keys (1994) investigated, students' scientific reasoning skills and changes in reasoning over time. Three ninth-grade pairs were studied while writing several laboratory reports in a period of several months. She found that collaborative writing encouraged students to construct their own understanding of science concepts. The students in her research improved their scientific reasoning skills and their ability to compose explanations that represented a synthesis of prior knowledge, active observations and other sources of information. According to Giroud (1999) collaborative writing may especially offer advantages in the case of argumentative text-writing. Learners may have different views or use different arguments which may result in a productive discussion. Moreover, argumentative discussion in itself can lead to co-elaboration and the transformation of knowledge (Baker, 1999).

Writing and collaborative interaction can be considered to be mutually supporting verbal learning activities, for they both generate verbal representations of thinking (cf. Keys, 1994). In collaboration as well as in writing students have to explicate and verbalize their thoughts. Verbalization and explication can be considered to be important processes making collaboration in writing an effective strategy (Giroud, 1999; Higgins, Flower, & Petraglia, 1992). It not only elicits awareness of one's own thinking, but it also makes ideas and writing processes more available for feedback and critical reflection. Students can become more aware by this of alternative points or strategies (e.g., Gere & Stevens, 1989; Giroud, 1999; Higgins et al., 1992). Important is that this feedback is not given on the final product, but on a draft in process. Writers are thus informed in an early stage of the meaning of the text for the reader and are able to check whether the goal of the text

is met (Gere & Stevens, 1989). Giroud (1999) also highlights the advantages of giving and receiving immediate feedback. She argues that discussions generated by the writing task make the collaborators verbalize and negotiate important things, for instance representations, concepts, arguments, text structure, goals, etcetera. This may lead to increased awareness and a more conscious control of the writing process. Moreover, this feedback may result in a socio-cognitive conflict, which is considered to be meaningful to learning (e.g., Brown & Palinscar, 1989; Dillenbourg, Baker, Blaye, & O'Malley, 1995; Doise & Mugny, 1984). Dale (1994) mentions socio-cognitive conflict as an element that may make collaborative writing effective, too. She found that successful groups in her study were involved in an authentic conversation about the emerging text and were engaged in productive socio-cognitive conflict. Higgins et al. (1992) mention cognitive conflict as an important process as well, for it can trigger critical reflection. Erkens, Jaspers, Prangma, and Kanselaar (2005) found that coordination processes, such as focusing on the topic of discourse, checking new information and argumentation about relevant task-related issues had a positive effect on the quality of the overall argumentation in collaboratively written essays.

Can collaborative writing contribute to domain-specific learning? The effect of collaborative writing on domain-specific learning has been hardly investigated, since most research on collaborative writing focuses on the writing process. Still, from a socio-constructivist perspective, it is maintained that integrating reading and writing activities with collaboration may enhance positive effects on learning outcomes (Tynjälä, 2001). Based upon the writing-to-learn hypotheses of Klein (1999; see Section 2.2.1), it can also be assumed that collaborative writing may contribute to domain-specific learning. For instance, the *forward search hypothesis* highlights the importance of revision processes and, as has already been pointed out, giving feedback is easily elicited in collaborative writing. Also, from the *backward search hypothesis*, in which writing is viewed as a problem solving process, collaboration can be considered to be important for transforming knowledge in such way that the rhetorical goals and constraints are met. In addition, a few studies found some evidence that collaborative writing may contribute to domain-specific learning and reasoning (Dale, 1994; Keys, 1994). Still, detailed analyses of learning processes and outcomes in this area are still lacking (Tynjälä, 2001). Moreover, little is known about how to support students while collaborating on a writing-to-learn task. The next section describes the possible role of CSCL, and in particular of external representational tools, in facilitating historical reasoning through a collaborative writing task.

2.4 Computer-support for collaborative writing in history

Computer technology can play a role in implementing collaborative learning and active knowledge construction in education (Kanselaar et al., 2000). Computer-supported collaborative learning environments (CSCL) are acknowledged as learning environments with the potential to provoke and

support the collaborative construction of knowledge, by representing learners' ideas and understanding, and by functioning as a social medium to support learning by dialogue (Andriessen, Baker, & Suthers, 2003; Lethinen, Hakkarinen, Lipponen, Rahikainen, & Muukonen, 2001). Despite the fact that the opportunities of CSCL are widely recognized, research in the field of CSCL has indicated that the use of CSCL is no guarantee for collaborative knowledge construction and learning (Lipponen, 2002; Stahl, 2002; Veldhuis-Diermanse, 2002). Lipponen, for example, states that there is no solid evidence that collaboration through computer networks leads to positive learning results. However, since studies using CSCL show a large diversity in tools, tasks and participants, it is difficult to make general remarks about the effectiveness of CSCL-environments, suggesting that it is important to gain insight into the effects of more particular characteristics of CSCL-environments in relation to the desired learning processes and outcomes specific to the learning task at hand. Hence, the following section first explores the potential role of CSCL in general in facilitating and promoting historical reasoning in a document-based writing task. Next, the focus is on the potential of collaborative construction of external representations to support the process of historical reasoning in text writing in CSCL.

2.4.1 History, computer-supported collaborative learning and writing

CSCL-environments have the capacity to provide support for collaborative knowledge construction on two levels: the level of communication and the level of the task (Erkens, 2004; Erkens et al., 2005). *Communication* in CSCL takes place either synchronous (for example in a chat), or a-synchronous (for example in a discussion forum). Computer-mediated communication (CMC) can be characterized as verbal and written. With respect to its characterization as verbal, non-verbal cues present in face to face communication such as face expression and intonation, are typically absent in CMC. Since non-verbal cues help to understand the meaning of what is said, the absence of it may give rise to misunderstanding. On the other hand, this absence may also compel students to communicate in a clear and explicit way, and to check for correct understanding with their partners. These two aspects are considered to be important prerequisites of good collaboration (Erkens, 2004). With respect to its' characterization as written, it can be pointed out that the writing activity in itself can be considered to be a tool for thinking and learning, enabling reflection and sharing of ideas (Hartley & Tynjälä, 2001; Lipponen, 2002; see also Section 2.2.1). However, written, as opposed to spoken, communication requires more effort and may be more time consuming (Baker, 2003). Again, this restriction may provide several advantages: it can constrain students to focus more on the task (Tiberghien & de Vries, 1997), and can provide them with the opportunity to take time for thinking before responding. CMC-systems can incorporate tools to compensate for the costs of writing. Examples of this are saving the communication history so that it becomes commonly visible and possible to reread it (Lipponen, 2002; Veldhuis-Diermanse, 2002), and structuring the interface in such a way that it can structure and support the interaction between the students, for instance by sentence openers (Veerman, 2000).

At the level of *task support*, CSCL offers possibilities to represent and share knowledge. Since task support can be considered to be more intimately related to the learning task at hand (in this thesis historical reasoning in a writing task), first the possibilities of CSCL to support historical reasoning will be discussed, and then the possibilities to support collaborative writing. In the domain of history, few studies have been carried out using CSCL-principles. Although there are some studies available that particularly aim at promoting (aspects of) historical reasoning by using computer technology, such as promoting chronological understanding (e.g., Masterman & Rogers, 2002), source use (e.g., Britt & Aglinskas, 2002), and historical thinking by using hypermedia (e.g., Spoehr & Spoehr, 1994), the computer environments used in these studies cannot be qualified as *collaborative learning environments*. The few studies that do use CSCL showed mixed results. Strobel and Jonassen (2004), for example, developed a system named Crisscrossing, combining hypermedia and CSCL-principles. The system enables students themselves to add their own materials and link them with existing material in the hypertext, thereby exposing them to multiple perspectives on the historical issue at hand. In addition to linking content, students can explain their reasons for doing so. Participants were undergraduate students, and their task was to study several cases in the field of American History of Religion Post Civil War. The environment enabled them to read case descriptions and related perspectives. They were instructed to produce links between perspectives and provide explanations for them. In addition, they were each given the assignment to write an essay. Results indicated that (1) the students experienced they were more actively constructing history, instead of passively consuming it, (2) students became more aware of different perspectives on the historical issue, and (3) they were more inclined to critically reflect on the sources. However, the use of the hypertext did not result in essays of higher quality than those written outside the hypertext system, and the degree of collaboration was disappointing (Strobel, 2004). Arvaja, Rasku-Puttonen, Häkkinen, and Eteläpelto (2003) examined the level of sharing and constructing knowledge in a web-based environment. Students of two secondary schools shared knowledge on the subject of imperialism through historical role characters. One school represented British society and the other Indian society in the nineteenth century. In a shared web-based learning environment students were able to send messages to each other from the perspective of their role character, and to participate in shared discussion. The results indicated that the knowledge level of the exchanged messages was quite low; the students mostly sent messages without sharing any relevant knowledge. Moreover, only a few interaction episodes reflected co-construction of knowledge, among which explaining and comparing. The authors concluded that the co-construction of knowledge in web-based interaction is not easily achieved. They explained their results (amongst others) by a lack of clear goals; there was no clear goal of the task nor did the students of the two schools share responsibility to perform the task. Although the results were not analyzed from the perspective of historical reasoning, this may provide another explanation of the results. The idea of role-play with historical characters is interesting, but also brings with it particular problems since it is very difficult for students to take the perspective of the historical character, and to

reason from his/her perspective (cf. Lee et al., 1997). These two examples show that CSCL can be used in a variety of ways in the domain of history learning, but also that it is difficult to engage students in productive interaction about the past.

In the present thesis task support is not only related to learning history, but also to collaborative writing, based on multiple documents. The potential role of computer technology in facilitating collaborative writing has been acknowledged by several researchers (e.g., Andriessen, Erkens, Overeem, & Jaspers, 1996; Erkens et al., 2001; Erkens, (Tabachneck-) Schijf, Jaspers, & Berlo, 2000; Hartley & Tynjälä, 2001). Computer technology makes close integration of reading activities (by providing access to information sources), writing activities, and group discussions possible; a form of integration that is assumed to contribute to domain-specific learning (Hartley & Tynjälä, 2001; Tynjälä, 2001). In Section 2.3.2 it has been pointed out that an important advantage of collaborative writing is the possibility to give and receive feedback during the writing process. Computer technology makes it easier to give feedback and to revise a text in the course of the writing process (Goldberg, Russell, & Cook, 2003). Additionally, computer-learning environments may also contain tools to support particular aspects of the writing process, such as tools for the planning and linearization of a text (Erkens et al., 2005).

Having discussed the potential of CSCL-environments in general to provide support at the level of communication and of the task, the next section will focus on the more specific issue of external representations, and their collaborative construction, as a means of promoting historical reasoning in text writing.

2.4.2 The potential of external representational tools

Relevant or effective tools in CSCL can be those that can be internalized by the learner and thus be used as “tools for thinking” (Salomon, 1990), and those that help learners to express, explain and discuss their ideas (Stahl, 2000). External representational tools (such as diagrams and matrices) are examples of these tools and frequently used in CSCL (Van Bruggen & Kirschner, 2003). When considering the potential of external representations, it is important to distinguish between using ready-made representations and the self-construction of representations (Cox, 1999). From a socio-constructivist perspective, the *self-construction* of representations, especially by groups of learners, is considered to be important for learning (Cox, 1999). Support for this idea can for example be found in a study conducted by Stern, Aprea, and Ebner (2003). They compared reasoning with ready-made representations with reasoning with self-constructed representations in the domain of economics and found that actively constructing representations resulted in more elaborated and more clearly organized knowledge structures. In addition, Schwartz (1995) compared the construction of external representations in individual and collaborative settings. It was found not only that dyads (tenth and eleventh grade) not only constructed more abstract representations than individuals when solving problems in the domain of science, but also that the group performances exceeded the performances of

the most competent individuals. The effects of the joint construction of external representations outside the science domain have hardly been investigated, since most studies focus on either ready-made representations or individual settings, and both mostly in the domain of science (e.g., Ainsworth, 1999; De Jong et al., 1998; Mayer & Chandler, 2001; Schnotz, 1993).

The potential of the joint construction of representations can be described both in terms of cognitive and of communicative processes (Erkens, Kanselaar, Jaspers, & Schijf, 2001; Suthers & Hundhausen, 2003; Van Boxtel & Veerman, 2001). From a *cognitive perspective*, the collaborative construction of external representations can be meaningful for several reasons. Firstly, the construction of a representation focuses attention on central problems, relations and structures in the task, and thus helps to distinguish central, main or core issues from more peripheral ones. This is referred to as graphical constraining (Scaife & Rogers, 1996; Suthers & Hundhausen, 2003). Secondly, a representation also makes immediately visible which information is missing, thus making students aware of knowledge gaps. Thirdly, and related to the first two, it can stimulate the process of elaboration, for it can refine and structure the content of students' knowledge (Stern et al., 2003; Suthers & Hundhausen, 2003). Fourthly, external representations can cause computational offloading, i.e., can reduce the amount of cognitive effort required to solve the problem (Duffy & Cunningham, 1996; Scaife & Rogers, 1996). Finally, by constructing a representation information is translated from one type of representation to another, thus supporting a deeper understanding and offering new views on the issue at hand (Cox, 1999; Jonassen, Peck, & Wilson, 1999). Although most of these advantages can also be present in individual settings, the collaborative construction of representation has additional advantages, since representations also incorporate a communicative function. From a *communicative perspective* the representation first of all functions as a point of reference that is accessible to all learners, and to which all learners can refer to. In addition, it is easier to refer to a visual representation than to an abstract description in text form (Clark & Brennan, 1991). Secondly, the collaborative construction of a representation can initiate the verbalization of knowledge and the negotiation of meaning that contributes to a shared understanding and a joint problem space between co-learners (Crook, 1998; Suthers & Hundhausen, 2003; Veerman & Treasure-Jones, 1999). The maintenance of a shared understanding between co-learners supports the co-construction of knowledge, as it enables pupils to build on each others' contributions (Baker & Bielaczyc 1995; Erkens, 1997; Veerman & Treasure-Jones, 1999). Thus, the collaborative construction of representations is, for its combined cognitive and communicative function, assumed to be a powerful activity contributing to learning.

Having described the role of the collaborative construction of external representations in general, the question arises to what extent it can support the process of historical reasoning in collaborative text writing. A distinction is made here between the influence on students' dialogue and on the writing of the text. Firstly, it follows from above that the collaborative construction of a representation can influence the interaction process between learners. In Section 2.3.1 productive

student interaction has been characterized as elaborated, co-constructed and domain-specific. It can be argued that the collaborative construction of representations can enhance co-elaboration by creating a shared context in which important information and relations become salient, and hence topic of discussion and sharing of ideas. This discussion may include domain-specific reasoning, and the use of domain-specific concepts. For example, research indicated that the collaborative construction of representations in the domain of physics resulted in a better learning of these concepts (Van Boxtel, 2000). In addition, Bell (2002) argues that both the representational artifact and the associated argumentation process can support and shape the process of reasoning (Bell, 2002). Not only does it facilitate students' capacity to reason, but it also makes it easier for students to reflect on their reasoning (Duschl, 2002). This reflection on reasoning is considered to be an important strategy for improvement in reasoning (Felton & Kuhn, 2002). Although it may consequently be hypothesized that the collaborative construction of representations can enhance historical reasoning, there is as yet no empirical evidence to support this assumption.

Secondly, the construction of an external representation may influence the process of text writing. In particular in the case of text writing on the basis of multiple sources, the construction of a representation in the planning phase of the writing process may enable students to organize information from different historical documents and help students to compare sources, discern and discuss different perspectives and related arguments. Rouet et al. (1996) have pointed out that writing in the domain of history requires the building of a situation model as well as the building of an argument model (see Section 2.2.2). Representations can offer support for both the building of a situation model (e.g., by representing the chronological order of events) and the building of an argument model (e.g., by representing the line of argumentation). Consequently, the constructed representation can be used as a writing aid (cf. Counsell, 1997). The role of external representational tools for collaborative writing in CSCL has been studied in the COSAR-project (Computer Support for Collaborative and Argumentative Writing; Erkens et al., 2000; Erkens et al., 2005). A groupware program was developed that enabled collaborative writing by students pairs (TC3: Text Composer, Computer-supported and Collaborative; Jaspers & Erkens, 2000). The TC3-environment (see also Chapter 4) offers access to relevant information sources, a private notepad, a chat facility and a shared word processor. The assignment was to write an argumentative essay of 600-1,000 words in which student pairs (upper-secondary education) had to convince the Minister of Health about their position on cloning or organ donation. The purpose of this project was to offer support in the planning phase of the writing process by providing specific tools for conceptual generation, organization and linearization (the Diagram and the Outline tool), and by offering help on using these planning tools. Both the Diagram and the Outline can be considered to be examples of external representations. The results indicated that in the chat dialogue coordination processes, such as focusing on the topic of discourse, checking new information, and argumentation about relevant task-related issues, were important elements that were positively related to the quality of the overall argumentation in the

written essays. From the COSAR-study it is concluded that proper use of the tools in CSCL can help students in their coordinating processes in a complex collaborative task. Consequently, it is suggested that the use of planning tools in collaborative writing stimulate a more structured dialogue (Kanselaar et al., 2003).

In sum, the collaborative construction of external representations can be considered to be a powerful activity in CSCL. Although it may be assumed that external representational tools are suitable tools to enhance co-elaborated and historical reasoning in online dialogues and to offer support for text writing on the basis of multiple documents, there is as yet no empirical evidence to support this assumption. Furthermore, it remains unclear what kind of representations are specifically suited to enhance the processes described above. De Jong et al. (1998) have argued that the format used to display information is an important dimension of external representations. Suthers & Hundhausen (2001, 2003) have pointed out that the cognitive and social affordances of a representation depend on the representational notation. In addition, Benton, Kiewra, Whitfill, and Dennison (1993) argued that the organization of the topic information in the representation influences the quality of subsequent writing. Although it can thus be assumed that the representational notation may be of influence, it has not been investigated exactly how different representational formats affect historical reasoning in dialogue and text writing.

2.5 Conclusions and research question

The general aim of this thesis is fostering historical reasoning in CSCL. Learning history can be described, both from a disciplinary and from a learning perspective, as the active construction of an image of the past based on information from historical sources. Historical reasoning can be considered to be a central activity of learning history. Historical reasoning has been described in this chapter as consisting of several components, which include (1) argumentation, (2) source use, (3) historical change, (4) historical explanation, (5) contextualizing, and (6) historical concepts.

How to engage students in historical reasoning? Two strategies have been proposed in this chapter: writing and collaboration. Firstly, we have argued that writing tasks can enhance historical reasoning and learning. Especially, research has indicated that writing an argumentative text based on the study of multiple sources (which is a typical activity in the domain of history) may foster historical reasoning. Since historical sources often provide partial and contradictory information and viewpoints, students need to identify these differences, compare them, and use the context to evaluate trustworthiness of the source. The claims they make should be backed with supportive arguments and evidence, and contra-arguments should be rebutted. Moreover, information about the characteristics of the time and place should be used to contextualize the historical event at hand, and changes need to be described and explained. The use of concepts, both substantive and methodological, is also important

in this whole process. Secondly, collaborative learning has been described as a strategy to engage students in historical reasoning. While collaborating, students have to express and verbalize their thinking to come to a shared understanding and agreement. The quality of the interaction process is an important prerequisite for learning. Interaction processes that may contribute to learning have been characterized as elaborated, co-constructed and domain-specific. Especially, the combination of these three features, here referred to as *co-elaborated historical reasoning*, is assumed to be important for learning.

Collaborating on a writing task might be useful, since writing and collaboration can be considered to be mutually supportive for they both generate verbal representations of thinking. Collaborative writing (i.e., co-authoring a text) enables students to discuss the content and the structure of the text. The possibility of giving and receiving immediate feedback may elicit co-elaboration, through asking and answering questions, discussing content, explaining and arguing. Taken together, collaborative document-based argumentative text writing may be expected to be a suitable task to engage students in historical reasoning both in dialogue and in writing. However, research on collaborative writing has thus far focused mainly on writing processes and argumentative processes, and it remains unclear whether and under which circumstances collaborative writing may contribute to domain-specific reasoning and learning in general, and for the domain of history in particular.

Computer-supported collaborative learning environments may be suitable environments to facilitate historical reasoning in dialogue and in collaborative writing, for they offer communicative and task-related support. Moreover, it offers possibilities to integrate reading activities, writing activities and collaborative discussions, which is assumed to contribute to domain-specific learning. However, research has indicated that using CSCL does not automatically lead to learning, and that it is not easy to elicit productive interaction between students. Hence, more research is needed to investigate the complex relation between characteristics of the CSCL-environment, the task, interaction processes and learning outcomes. In addition, since little research has been conducted on history learning and CSCL, it is important to gain more insight into whether and how task-related tools can facilitate and support historical reasoning.

In this thesis we will particularly focus on the effects of external representational tools in CSCL on historical reasoning in dialogue and text writing. From a socio-constructive perspective, it is assumed that the collaborative construction of representations by students contributes to learning. The collaborative construction of an external representation during the planning phase of a writing task can be hypothesized to facilitate not only co-elaborated historical reasoning in on-line dialogues, but also to offer support for collaborative text writing. In this study, this hypothesis will be investigated. Moreover, as it is assumed that the representational format may influence interaction processes, different representations will be compared in this study. Thus far, systematic comparisons of external

representational tools in CSCL are scarce (Van Bruggen & Kirschner, 2003). Hence, the general research question for this thesis can be formulated as follows:

How does the collaborative construction of different external representations in CSCL affect historical reasoning in dialogue and collaborative text writing?

The following chapter will describe the method we used to investigate this research question.

CHAPTER 3 METHOD OF THE STUDIES

This chapter presents the methods used in the empirical studies that are reported in the following three chapters (Chapters 4, 5 and 6). Although these chapters also contain a methodological section, the purpose of this particular chapter is to provide a more complete and detailed overview of the methods used. However, there is some overlap between this chapter and the method sections of the following chapters. Subsequently, the research questions and the design of the studies, the participants, learning environment and task, the procedure, the conditions, and the instruments and analyses are described.

3.1 Research questions and design

The purpose of this thesis is to gain insight into facilitating the process of historical reasoning in a document-based writing task in CSCL by providing representational guidance. It is assumed that co-elaborated historical reasoning in on-line dialogue will contribute to writing and learning as measured in group products (texts) and individual learning outcomes. Moreover, it is hypothesized that the collaborative construction of external representations by learners fosters co-elaborated historical reasoning in chat discussions and that different representational formats will influence the reasoning process. The general research question is formulated as follows:

How does the collaborative construction of different external representations in CSCL affect historical reasoning in dialogue and collaborative text writing?

To answer the main research question the following questions will be investigated:

1. *Is a collaborative writing task in CSCL a suitable task to engage students in historical reasoning?*
2. *What are the effects of the type of historical inquiry question (explanatory and evaluative) on collaborative historical reasoning in chat discussions and text writing, and on individual learning outcomes?*
3. *How does the collaborative construction of different external representations affect:*
 - a. *historical reasoning in chat discussions*
 - b. *historical reasoning in text writing*
 - c. *individual learning outcomes?*

The emphasis will be on the third question, the first two questions are more preliminary. To investigate the research questions an experimental design is used. A pretest and post-test were

administered to indicate individual learning outcomes. Nowadays, research in CSCL does not always present data on learning outcomes (Lethinen, Hakkarainen, Lipponen, Rahikainen, & Muukonen, 2001), and when learning outcomes are reported, these often are group products and not individual learning outcomes. Since it is assumed here that collaborative historical reasoning contributes to learning, combining both collaborative and individual outcomes may provide interesting additional insights. In order to answer the third research question, the quality of the constructed representations in the different conditions is also investigated. The experiments were carried out within a school setting, during history lessons.

Two experimental studies were conducted over a period of three years (see Table 3.1). In the first study, conducted in the first year, the focus was on the task. The aims of this study were twofold. The first aim was to gain insight into whether a collaborative writing task is suitable to engage students in historical reasoning. For this, two types of historical writing tasks were compared. The first task focused on *explaining* a historical event, whereas the second task focused on *evaluating* a historical event. Both types of task are often used in Dutch history education. Secondly, the results of this study were used to gain insight into the problems students faced while executing the task. This information was used to decide what processes should be supported in the next study. After all, before we know what to support and how to support it, it should first be determined what learners actually do (Kirschner, 2002). The results of this study will be reported in Chapter 4.

The second study builds upon the results of the first study. The task used in this study is the task that turned out to have the better results in relation to promoting historical reasoning. Furthermore, information about students' historical reasoning is used to design additional support tools. The purpose of this second study was to examine how the collaborative construction of different representations affected students' historical reasoning, the writing product and individual learning. This second study was carried out over a period of two years. In the first year two representational tools were compared: An argumentative diagram and an argument list (see Section 3.5.2 for a detailed description of the representational tools). Although both tools aim at supporting argumentative reasoning, differences can be found in the structure of the representation. The results of this comparison will be reported in Chapter 5. In the second year, two conditions were added to the experiment. In the Matrix condition, students were provided with a representational tool which was expected to be more domain-specific. Furthermore, a Control condition was added in which students made the same task in the same environment, but without the representational tool (see Section 3.5.2 for a detailed description). Chapter 6 reports on the results of the comparison of the four conditions, i.e., the Matrix and Control condition of the second year and the Diagram and List condition of the first year (thus the data of the Diagram and List condition are used both in the Chapters 5 and 6).

Although the second study was carried out over a period of two years, we consider it to be one experiment. To reduce the effect of differences between the students due to contextual factors, it was decided to work with the same schools in both years. The students from both years thus came from the

same social background, had been taught by the same teacher, and used the same history text-book (more information about the participants can be found in the following section). The students from one history class were randomly assigned to pairs and to one of two conditions of that year. So, in the first year students were assigned to either the Diagram or the List condition, and in the second year to either the Matrix or Control condition. Randomization took thus place within the two years, but not over the years. Since randomization did not take place over the four conditions, it might be possible that differences between the conditions are due to differences in school year. By comparing the results of these four conditions, the influence of the different representational tools on historical reasoning in chat discussions and in text-writing, and on individual learning outcomes can be examined.

Table 3.1

Overview of the empirical studies

Year	Experiment	Conditions	School	<i>N</i>
2001	1	Explanation and Evaluation task	A	20
2002	2a	Diagram and List tool	A and B	60
2003	2b	Matrix tool and Control condition	A and B	70

3.2 Participants

Subjects of both studies were 16 and 17 years old students from history classes in pre-university education (in Dutch: 5 VWO). Pre-university students were chosen because both historical reasoning and source-based text writing are quite complex activities. The students came from two different schools. School A participated in all three years of the experiment (see Table 3.1). School A has been founded on ideas from the New School Movement, especially on the ideas of Kees Boeke (see also Wyatt, 1956) in which special attention is given to collaborative learning. Compared to school A, school B can be characterized as a more traditional school in the country-side. In the first experiment (described in Chapter 4) 20 students of one history class from school A participated. The students were randomly assigned to pairs and to one of the two conditions. In each condition 5 pairs (10 students) participated. As mentioned above, the second experiment was conducted over a period of two school years. In the first year the experiment was conducted for the Diagram and List conditions, and in the second year for the Matrix and Control conditions. Again, the students from each class were randomly assigned to pairs and to one of the two conditions of that year. In both years, students of three history classes of the two schools participated (see Table 3.1). A total of 157 students participated in the second study. Students who missed more than one lesson were excluded from the analyses, as were students who had to work alone due to an uneven number of students in one class. The analyses included 130 students: 16 student pairs in the Diagram condition, 14 in the List condition, 18 in the Matrix condition, and finally 17 student pairs in the Control condition.

Although all students had some experience with the use of computers, they had hardly any experience with groupware environments. Furthermore, they had some experience with collaborative learning (especially students from school A) and with inquiry tasks, but less experience with text writing in the domain of history. Text writing is not very often used in history lessons in the Netherlands, nor is it part of central examinations (as for example in Great Britain). The topic of the task was only familiar to the students in a general way, since it had not been instructed beforehand.

3.3 Learning environment and task

As has been pointed out in Section 2.4, computer-supported collaborative learning environments are assumed to be suitable environments to support collaborative knowledge construction, because they can provide support on both a communicative and task level. Since CSCL offers possibilities to communicate and represent ideas and provides access to information sources in a single environment, it is expected to be a suitable environment for a collaborative document-based writing task. In the studies described in this thesis a CSCL-environment for collaborative text writing is used that has been developed at the Department of Educational Sciences at Utrecht University. This environment combines a shared word processor, a chat facility and access to a private notepad and information sources. In the first study, described in Chapter 4, the program TC3 was used (Jaspers & Erkens, 2000). TC3 stands for Text Composer, Computer-Supported & Collaborative. In the second study (see Chapter 5 and 6) the program VCRI (Virtual Collaborative Research Institute) (Jaspers & Erkens, 2002) is used. VCRI is the successor of the TC3 program. Although VCRI contains some additional possibilities (i.e., collaboration of larger groups instead of only dyads in TC3, communication between groups, and teacher intervention), it was used in the same way as TC3 (i.e., shared word processor, chat, private notepad, and a database with information sources, see Figure 3.1). Detailed descriptions of the environments, as well as a figure that shows the VCRI environment, can be found in the following chapters.

It has been pointed out in Chapter 2 that a collaborative writing task on the basis of the study of multiple sources can be a suitable task to elicit historical reasoning. For the purposes of this research project, a historical source-based writing task was developed concerning the changes in the behavior of Dutch youths in the 1960's. The task was developed by the author (who has professional experience in developing historical inquiry tasks), and in cooperation with a text-book editor and an experienced history teacher who also has professional experience in designing history tasks. The first version of the task was improved by the comments of two experts in history education, and the comments and performances of two first-year students of Educational Sciences, who had carried out the task.

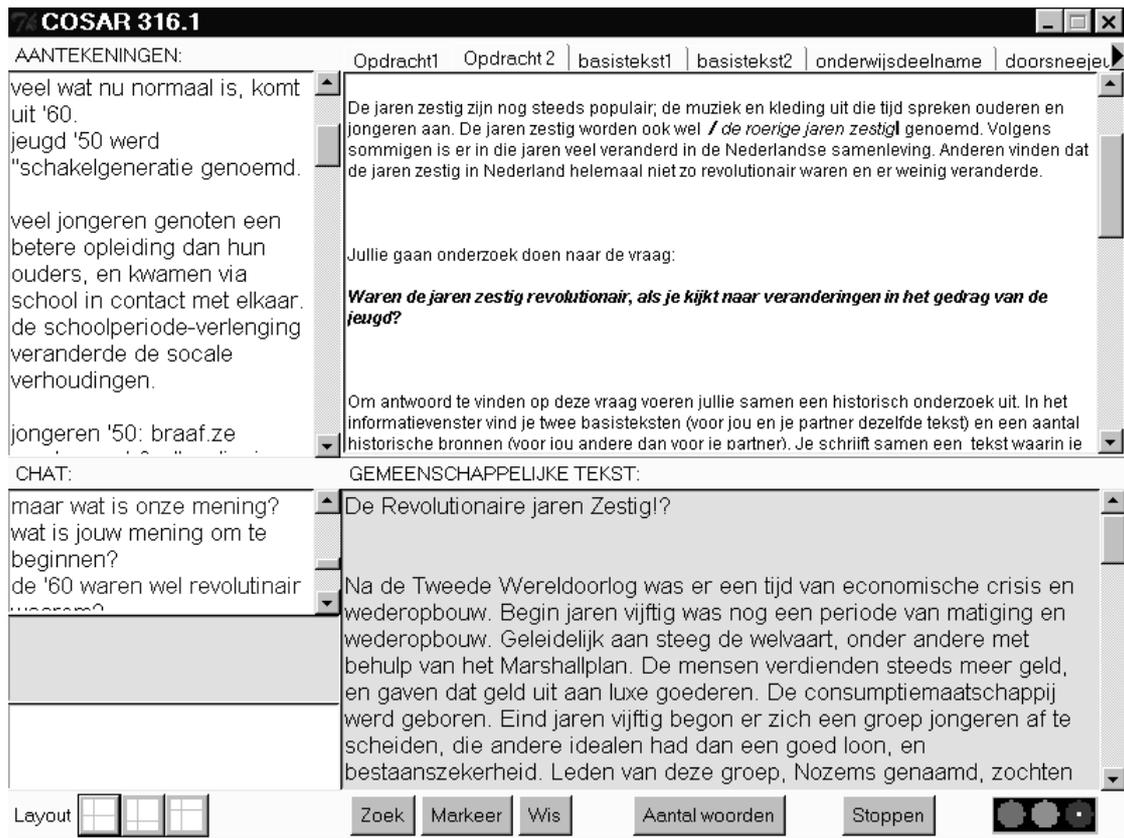


Figure 3.1. Main screen of the TC3 program used in the first study.

The task involved studying multiple sources and writing a text of approximately 1,000 words. A complete description of the task can be found in Appendix A, including a description of the sources. It was decided to provide students with a set of selected sources instead of letting them search for information sources themselves (which is often common practice with inquiry tasks). When students had to search for information themselves, differences in text quality could be due to differences in the information found. The set of selected sources consisted of different types of sources describing changes and/or viewpoints about the revolutionary impact of the changes. The sources, primary as well as secondary, included descriptive texts from textbooks, pictures, tables, interviews, and different accounts of historians. Since in the second study only the evaluative inquiry task was used, some changes were made in the original set of sources compared to the set used in the first study. (Note that the description of the sources in Appendix A is of the set used in the second study). A few sources that especially focused on explaining the changes were replaced by sources that focused on the revolutionary impact of the changes. A collaborative writing task based on the study of multiple sources fits a recent Dutch educational reform of upper secondary education (the so-called “Study House”) in which more attention is given to independent learning, collaborative learning, and inquiry learning. Furthermore, nowadays more emphasis is given to the use of computer technology in the Dutch classroom.

As mentioned above, the topic of the task was the changes in the behavior of youths in the 1960's. This topic was chosen for several reasons. Firstly, the topic fits within the history curriculum for upper secondary education. Secondly, different points of view exist about the impact of the changes on the behavior of youths. This made it possible for students to discuss different viewpoints and establish their own point of view. Thirdly, at the time the task was designed the topic was being discussed in newspapers. Finally, the 1960's are quite popular nowadays, for example in music and fashion. It was therefore expected that this topic would be interesting for students. The task was designed in such a way that it could be accomplished independently of other parts of the curriculum, text books and teacher instruction. The students did not study or receive any instruction about the topic in advance nor did the teacher give instruction or feedback during the executing of the task.

The task was designed in such a way that it met the demands set for good collaborative tasks (cf. Cohen, 1986). Text writing on the basis of multiple documents is a complex and ill-structured task, with no fixed answer, and different points of views are possible (and presented in the documents). The common goal students have is to come to agreement about the historical issue presented and the writing of a text for which they both share responsibility. In addition the text was graded as a joint product. These characteristics make it necessary for the students to share ideas, to coordinate their activities and to negotiate meaning. In this way positive interdependency is created (Cohen, 1986; Johnson & Johnson, 1992). In addition, to accomplish the task they need to share both tools and activities. In the first study described in Chapter 4, the sources were divided between the students of each pair, which made it necessary for the students to share the available information. The sources were divided in such way that both students could get an overview over the period and of the different points of view (thus the sources were not divided in such a way that one student received all sources for and the other all sources against). In the second study (Chapter 5 and 6), all sources were available to both students of a pair. However, during the instruction it was suggested to divide the sources, for there were many sources available. As mentioned above, the students worked on this task in dyads. Working in dyads requires active participation of both students, and hence the so-called free-rider effect is less apparent.

3.4 Procedure

The following procedure was used for the empirical studies. First, the pretest was administered. In the next session an instruction was given about the use of the learning environment, in which the students were also given the opportunity to use the environment themselves. Some instructions about the procedure of the experiment and the task were given as well. This instruction was also handed out on paper. In addition, it was pointed out to the students that all their activities would be logged and that the researcher would read all their chat communication. The following six sessions (of 50 minutes

each) were used for the execution of the task. In the experimental conditions of the second study the students were told first to construct the external representation, after which they could start writing the text. In the condition in which no representation was to be constructed (i.e., the first study and the control condition of the second study) the students could plan their own activities. To prevent the students from not having enough time to write the text, it was suggested they had the representation finished at the end of the fourth session.

During the execution of the assignment, each student worked behind his or her computer, separated from the partner who worked in a different computer lab. In the first session after the task was finished the post-test was administered. And finally, the students were asked to fill out a questionnaire containing evaluative questions about the task and the computer environment (see Appendix C). All experiments were completed within three weeks. The author of this thesis administered the pretest and post-test, gave the instruction, and was present during all the working sessions.

Since the assignment was part of the history curriculum, students received a grade for their performance on this task. In the first study, the students received a grade based on the quality of the written text. Both collaborating students received the same grade. Since it turned out that the students in the first study were less motivated to accomplish the post-test, it was decided to also give a grade for the post-test in the second study. The final grade for the task was thus measured as the means of the score on the writing task and the individual performance on the post-test. Consequently, it was possible that students who worked together on the writing task received different grades dependent on their performance on the post-test. The grades the students received were not used for the analyses.

Finally, from a more practical point of view, it may seem somewhat artificial that pairs of students were divided over two computer labs and worked together on planned hours, instead of working in their own time and at their own place. However, this was necessary since synchronous communication was used in the experiments (which was explained to the participating students and teachers). Because the pairs of students saw each other in between the sessions in which they worked on the assignment, their discussing task-related issues could not be prevented. To get insight into whether this was actually the case, an item about this was formulated in the questionnaire.

3.5 The conditions: Types of inquiry questions and representational tools

3.5.1 Study 1: Types of inquiry questions

A writing task based on the reading of multiple sources is assumed to enhance historical reasoning (e.g., McCarthy Young & Leinhardt, 1998; Perfetti, Britt, & Georgi, 1995; Rouet, Britt, Mason, & Perfetti, 1996; Voss & Wiley, 1997; Wiley & Voss, 1996). The purpose of the first study was to find out whether a collaborative writing task on the basis of the study of multiple sources would be a

suitable task to foster historical reasoning in CSCL. Consequently, this study explored the influence of the type of inquiry questions on historical reasoning in chat discussions and writing. Within the domain of history three types of inquiry can be distinguished: descriptive (“What kind of weapons were used during World War I?”), explanatory (“What caused World War I?”), and evaluative (“Is Germany mainly responsible for World War I?”) (see also Wester, Van Drie, & Sniekers, 1998). Two types of historical inquiry questions that are both often used in Dutch history education were compared in this study. The first task focused on *explaining* a historical change (“How can the changes in the behavior of Dutch youths in the 1960’s be explained?”), and the second on *evaluating* possible interpretations of (the same) historical change (“Were the changes in the behavior of Dutch youths in 1960’s revolutionary?”). It was hypothesized that the latter would elicit more historical reasoning, since research indicated that writing an argumentative text on the basis of multiple sources especially enhances historical reasoning and understanding (Voss & Wiley, 1997; Wiley & Voss, 1996).

3.5.2 Study 2: Representational tools

In the second study, the influence of three representational tools on interaction and learning outcomes was compared: an argumentative diagram, an argument list, and a matrix. Within the given task, the construction of an external representation was to be deployed during the planning phase of the writing process. Within this task, it is assumed that the joint construction of an external representation has three distinct functions. Firstly, it may function as a means to select, categorize and organize important information from the historical sources. Secondly, because the representation is part of the shared context, it can elicit discussions about concepts, relations and structure. As mentioned in Section 2.4.2, it can be hypothesized that it elicits co-elaborated historical reasoning. And thirdly, both the content and the structure of the constructed representation can be used for the writing of the text. Assuming that representational tools mediate collaborative learning interactions, for they can make knowledge salient and constrain what is discussed (Suthers, 2001) it was hypothesized that features of the representational format would have influence on students’ dialogue. For example, it can be hypothesized that different representational formats can support different components of historical reasoning. A causal diagram may provide guidance when learners are asked to explain historical events, and an argumentative diagram may be used in the case of evaluative question, whereas the construction of a timeline may be useful for understanding chronology (cf. Masterman & Rogers, 2002). Furthermore, the different representational frameworks may impose a meaningful structure on the information, which may help to make decisions about the writing of the text, which may result in differences in the quality of the text. To test these hypotheses different representational formats were compared. Within CSCL-research systematic comparisons between external representational tools are scarce (Van Bruggen & Kirschner, 2003). The choice for the representational formats is closely related to the focus of the task. The task requires students to decide whether the changes in the behavior of

youths in the 1960's were revolutionary or not. Hence, central components of historical reasoning in this task are historical change, and taking a point of view and support this with arguments. The representational formats are supposed to support especially these components of historical reasoning; the process of argumentation and reasoning about historical change, which was an important criterion for the choice of a representational format. Below, characteristics of the three representational formats will be discussed in more detail.

Argumentative diagram

In an argumentative diagram, a point of view and arguments pro and contra can be graphically represented and organized. Figure 3.2 shows the diagram tool used in the study. Viewpoint, arguments pro and contra, and examples can be represented in text boxes (each with their own color). All text boxes can be linked to one another by arrows. Furthermore, students can refer to the source from which the argument or the example derives.

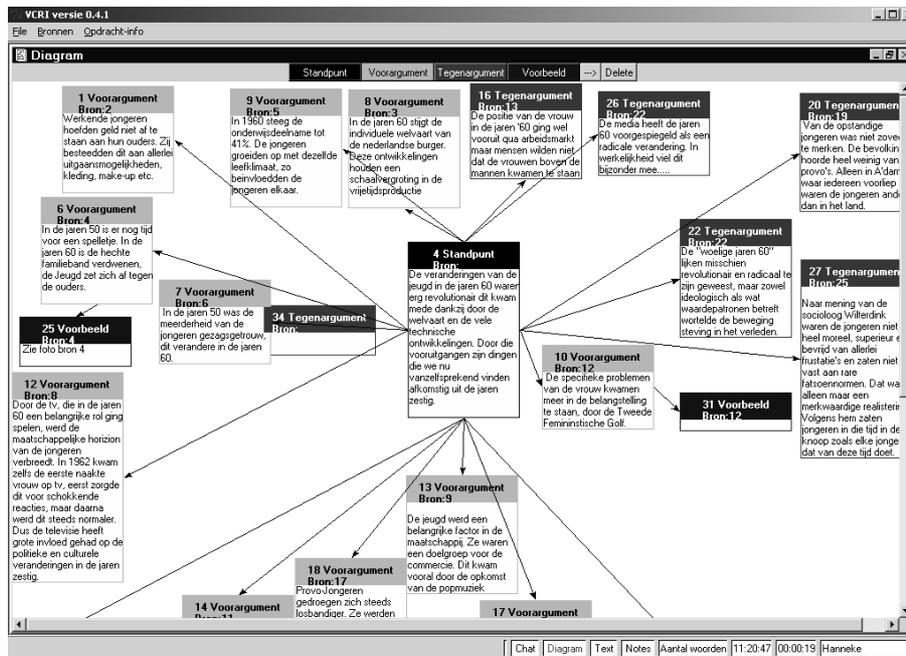


Figure 3.2. Example of an argumentative diagram.

The task requires students to take a point of view on whether the 1960's were revolutionary, and support this with arguments. The construction of an argumentative diagram can offer support to select and identify arguments for and against. It can be expected that students become more aware of the different perspectives of historians with regard to this issue. Hence, it can be expected that it may elicit discussion about the different perspective of historians, and about the trustworthiness of the sources. Moreover, since students show a tendency to focus only on supporting arguments, the construction of a diagram may focus them on arguments contra and to take into account alternative views. In the diagram it is easily visible when only (or more) arguments pro are represented. Research indicated that

the construction of a diagram can support elaboration and co-construction by maintaining focus (e.g., Suthers & Hundhausen, 2001; Veerman, 2000). On the other hand, in a recent comparison between a diagram tool and an outline tool for collaborative text-writing in CSCL, the Diagram tool turned out to be less successful (Kanselaar et al., 2003).

List

Just as the argumentative diagram, the list focuses on the process of argumentation. However, the list organizes arguments in a more linear way, whereas an argumentative diagram organizes and links arguments in a two-dimensional graphical way. The list tool is shown in Figure 3.3. In this window, students can put together the different arguments. The arguments can roughly be organized in two different ways: (1) by putting together the arguments for and the arguments against, and (2) by ordering the arguments by the number of the source they derive from. Since the main difference between the list and the diagram is the structure of the arguments, it can be expected that the construction of the list elicits less discussion about this structure and about the relation between the different arguments. Moreover, it can be expected that this also influences the quality of the text. In addition, it is less directly visible whether about as much arguments for and against are represented. It is thus expected that the balance between the arguments for and against would be less compared to the diagram. Furthermore, the construction of a list may require less co-construction between the students, since in the list students only have to add arguments instead of linking one student's argument to an argument added by the other students (as in the diagram).

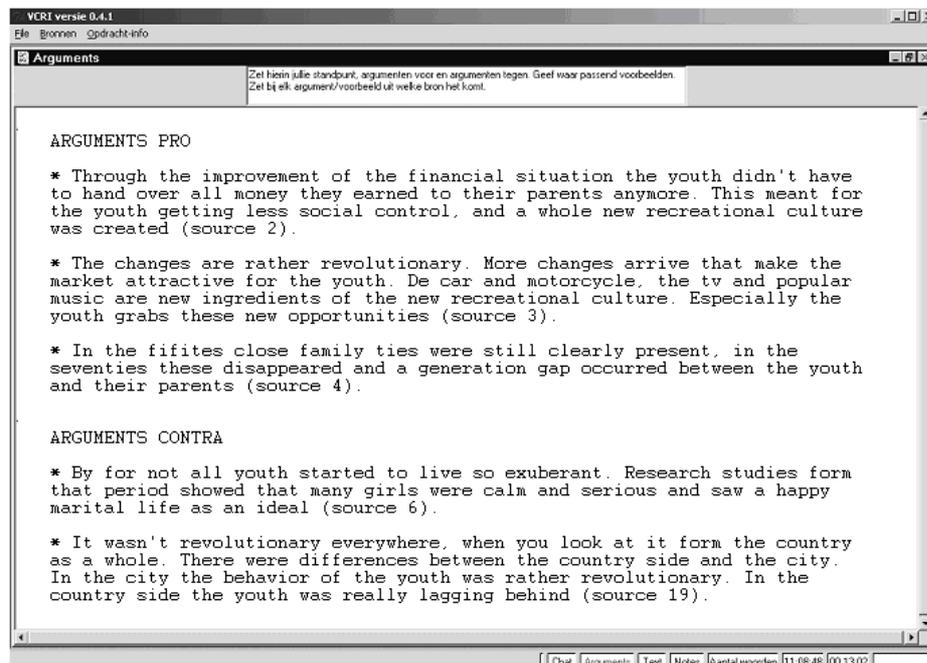


Figure 3.3. Example of a list.

Matrix

Whereas the argumentative diagram and the list pay explicit attention to the argumentation process, the matrix focuses on another important aspect of the task, i.e., historical change. Historical change can occur in very different areas, for instance beliefs, economic situation or family life. In describing and evaluating processes of change, historians often distinguish between political, economic, social and cultural changes. Furthermore, they characterize changes according to their speed and impact. A matrix is a format in which changes can be characterized by means of several columns. Figure 3.4 shows the matrix tool used in the study. The matrix consists of a table format that can be filled in by the students. In the second column the number of the source can be added, in the third column students can describe the historical changes (or aspects of continuity) and in the fourth whether they think the change can be defined as revolutionary or not (including possible reasons). The last column contains a “sort” function. Students can categorize the changes in the way they choose. When they push on the sort button, all the changes are sorted. For example, the students who made the matrix in Figure 3.4 categorized the changes as cultural, political and economic. Another possibility is to sort on the basis of the characteristic of revolutionary change, by filling in “revolutionary” or “not revolutionary” (in that case columns four and five contain the same information). After sorting, all changes with the same label are listed.

id	Source	Description Changes	Revolutionary change?	Sort
5	00	Old ways of living, traditions and cultures were partly lost, secularization and decline of the youth movement	YES	Culture
6	00	Interference by the government decreased during the 1950s but did not disappear	NO	Politics
7	00	strong demand for fundamental changes during the 1960s	YES	Politics
9	02	Youngsters earned more money, so they did not need to give up their complete earnings to their parents	YES	Economy
8	03	New types of leisure activities due to increasing wealth	No	Economy
10	04	Parents had more time to spend time with their families	NO	Culture
11	05	Because the number of people pursuing an education increased rapidly, social differences between people diminished.	YES	Education
13	07	Nozems were not accepted by society. They were considered hopeless cases.	NO	Politics
12	08	The influence of television grew strongly during the 1960s, a structural depillarization took place, although depillarization was still visible in broadcasting	YES	Culture
17	09	The rise of new music was widely noticeable. Young people in particular were attracted by it.	Yes	Culture
14	10	Youth culture changed significantly between the 1950s and the 1960s; as became visible through the rise of popular idols, and a tendency to revolt against grownups.	YES	Culture

Figure 3.4. Example of the matrix.

The structure of the matrix may invite students to fill in all the empty boxes, which can thus elicit elaborative discussions among students (cf. Suthers, 2001). In relation to the process of historical reasoning it is hypothesized that compared to the diagram and the list, the matrix may elicit more discussion about historical change and the impact of the different changes, because the matrix prompts students to fill in for each change whether it was revolutionary or not. As in the diagram, in the matrix it is easily visible whether information is missing. However, this effect may even be stronger for the matrix, for contrary to the diagram it is clear when the construction of the matrix is “finished” (namely when all the boxes are filled), whereas to a diagram boxes can always be added, and the structure can be changed. This may give students working with the matrix a sense of certainty. Furthermore, the organization of information in the matrix may be advantageous for text writing (Benton, Kiewra, Whitfill, & Dennison, 1993). The matrix roughly offers two ways of categorizing the information (in type of change and whether or not revolutionary). Both organization principles can be used to structure the text.

Control condition

The effects of the three representational tools were in this study compared to one another and to a control group. In the control condition students made the same task in the VCRI environment, however, there was no representational tool available. It was assumed that by adding a control condition to the experiment, the effect of the construction of different representations would become more clear.

The control condition was the same as the evaluative condition of the first study. However, it was decided not to use the evaluative condition of the first study as a control group in the second study for two reasons. Firstly, the number of participants (5 pairs) turned out to be too small for a valid comparison. Secondly, a different computer program was used in the second study. Although this program offers the same facilities as the program used in the first phase, we wanted to rule out differences due to differences in the computer environment.

3.6 Instruments and analyses

In these studies both the learning process and the learning products are analyzed. Salomon (1990) makes a distinction between the effects *with* CSCL, and the effects *of* CSCL. The effects *with* are to be found in the interaction between the students (i.e., chat dialogue), and the *effects of* are to be found in the residues of the collaborative activity, both on a group level (i.e., text) and on an individual level (i.e., post-test). All actions of the students while executing the task were logged. The main focus of the analyses is historical reasoning. The components of historical reasoning identified from literature (see Chapter 2.1) were used as a framework to analyze the chat dialogues and the texts. Moreover, these

components inspired the construction of the pretest and the post-test. Below, the different analyses will be described in detail.

3.6.1 *Interaction Analyses*

It is now widely acknowledged that gaining insight into collaborative learning processes requires detailed analyses of the content of the communication (Strijbos, 2004; Veldhuis-Diermanse, 2002). Hence, researchers developed various methods and coding schemes that met their specific demands in relation to their specific research questions, data and so forth. Two important approaches can be discerned (Strijbos, 2004; Wegerif & Mercer, 1997). Whereas the *qualitative approach* deploys methods such as phenomenography, ethnography and participant observation, in the *quantitative method* the communication is coded and frequencies are used for statistical testing. The latter approach will be used in this study, for it makes it possible to analyze sets of data by explicit criteria, and to make systematic comparisons between different conditions. In this way, the influence of different representations on historical reasoning in on-line dialogues can be examined. We developed a coding scheme to categorize chat utterances; subsequently, frequencies were calculated and analysis of variance was used to detect possible differences between the conditions.

In order to analyse the chat protocols the computer program MEPA was used (Multiple Episode Protocol Analysis; Erkens, 2002). MEPA offers a flexible environment for the qualitative and quantitative analysis of collaborative dialogue protocols. The chat protocols were analyzed on the level of utterances. The chat data were divided into utterances, based on the use of the 'enter' key by students. Most often, the chat utterances were short and contained only one single function. When a chat utterance was compounded and contained two or more functions, the utterance was split (according to their function). Each chat utterance received a single coding. Inter-rater agreement was calculated to measure the reliability of the coding. However, this can not completely prevent validity problems, as Wegerif and Mercer (1997) have pointed out: The interpretation of utterances can be problematic, for utterances are often ambiguous in meaning, may have multiple functions, and meanings may change over time.

Peer dialogue is often analyzed on both a communicative and a content level (Van Boxtel, 2000). In the coding scheme we developed and that will be presented below, interaction processes are analyzed on a content level. A hierarchical system is used to analyze the chat utterances. First, all utterances were analyzed on the level of task acts. Next, utterances coded as historical reasoning were analyzed on three dimensions: 1) type of historical reasoning, 2) elaboration, and 3) degree of co-construction. These three dimensions relate to three important perspectives that can be used to analyze peer interaction (see Section 2.3.1). The coding schemes were inspired by already existing coding schemes (with the exemption of "type of historical reasoning", which was newly developed), which were adapted to our purposes and data. Below, the coding schemes for consecutively the task acts and historical reasoning will be presented and described.

Task acts

Since we are especially interested in the content of the chat discussion, all chat utterances were first analyzed on the level of Task acts. Task acts refer to the function of the utterances in relation to the execution of the task. Since we particularly focused on historical reasoning, the purpose of the analysis of the task acts was to characterize the chat dialogues in a more general way and to identify historical reasoning utterances. This coding scheme is based upon the Task act coding scheme described in Erkens, (Tabachneck-) Schijf, Jaspers, and Berlo (2000), which has especially been developed to analyze chat communication in a collaborative writing task in CSCL. This coding scheme was adapted to our purposes and some categories were changed while analyzing the data. For example, the category Historical reasoning was added, as well as the category Greetings. The students worked for six lessons on the task, divided over two weeks. Each lesson started with greetings, often consisting of several utterances. It was considered to be important to distinguish these greetings from social talk during the task. We distinguished five main categories of Task acts (see Table 3.2): Task, Procedure, Program, Social, and Greetings. Additionally, the categories Task and Procedure were further divided into subcategories, which are also described in Table 3.2.

The interrater-agreement for the coding of the Task acts was calculated over three randomly chosen chat protocols of the first study (in sum 1333 utterances). Cohen's κ for the five main categories turned out to be .77 (agreement 83%), for the subcategories Task .85 (agreement 87%), and for the subcategories Procedure .83 (agreement 91%).

Table 3.2

Coding definitions of task acts

Category	Description	Example
<i>Task</i>	<i>Expressions concerning the content of the task and related to the:</i>	
-Historical reasoning	historical content of the task, including the content of the historical sources	I think the Sixties were revolutionary, because a lot changed during that period.
-Text construction	construction and structure of the text	Shall we start with an introduction, followed by a paragraph about the changes in the Sixties?
-Text revision	revision or addition of specific text	We need to add something about the influence of TV in this part.
-Goal	verification of meeting task demands	We should state something about the changes in the behavior of the youth, for that was the task.
-Resources	use of the information sources (not discussing the content of the source)	I have an interesting source about Provo.
-Representation ^a	construction of the external representation (not content)	We have to add another argument contra, for we hardly have any.
-Evaluation task	evaluation of content of task, representation or text	This task is difficult! The conclusion is badly written.
-Word count	check of the number of words written.	We already have 700 words.

<i>Procedure</i>	<i>Expressions concerning the organization and planning of the task</i>	
-Approach	general approach of the task	Shall we discuss how to approach the task?
-Evaluation	evaluation of the task approach or organization (not an evaluation of the task or text)	I enjoyed working with you. We made a good task planning.
-Turn-taking	coordination of turn taking	Shall I continue writing?
-Coordination	coordination of actions	What are you doing at the moment?
-Planning	coordination of time	We should start writing the text tomorrow.
<i>Program</i>	<i>About technical aspects and program-related matters.</i>	<i>How can you copy from the notes?</i>
<i>Social</i>	<i>Concerning topics not related to the task or the program, but with a social function.</i>	<i>Did you see that movie on TV last night?</i>
<i>Greetings</i>	<i>Greetings at the beginning or end of a working session.</i>	<i>Hi Monique, how are you today?</i>
<i>No Code</i>	<i>Not related to one of the above categories</i>	

^a The subcategory Representation was added for the second study described in Chapters 5 and 6

Historical reasoning

Peer interaction in the domain of history has hardly been investigated and therefore there hardly are any coding schemes for the analysis of historical reasoning in student interaction. An exception is the coding scheme of Pontecorvo and Girardet (1993) who developed a categorization system to analyze historical reasoning and arguing in face to face peer interaction. In their scheme they distinguish between *argumentative operations* giving an account of the collective discursive activity, and *epistemic operations* through which the specific knowledge domain is analyzed. According to Pontecorvo and Girardet, these epistemic operations correspond to the explanation procedures used to describe and interpret historical events. The following five categories are distinguished: Definition, Categorization, Predication, Evaluation, and Appeal to. The latter category is described as “the action of supporting a claim by appealing to something that the speaker considers relevant to the topic. The content of the appeal can be:

- a. Analogy
- b. Exemplar cases or instances
- c. Conditions
- d. Rules, general principles
- e. Motives/intentions/goals
- f. Consequences/implications
- g. Authority (expert, author, source)

- h. Time
- i. Socio-cultural context
- j. Spatial and temporal context” (p. 374).

In these ten subcategories the components of historical reasoning (as described in Chapter 2.1) can be distinguished. For instance, Time (h), Socio-cultural context (i), and Spatial and temporal context (j) resemble the component of Contextualization; Motives (e) and Consequences (f) relate to Explanation; and Authority (g) to Sources. However, whereas Pontecorvo and Girardet’s scheme includes the subcategories Analogy, Exemplar cases, Conditions and Rules, the component Historical Change is missing. A more important difference is that the main construct of Pontecorvo and Girardet seems to be “argumentation” instead of historical reasoning. The five main categories of Pontecorvo and Girardet reflect more general epistemic operations, and the particular historical aspects are found in the subcategories of the Appeal to-category. Consequently, the subcategories have a specific function, namely supporting claims, and the historical dimension functions only in relation to the process of argumentation. In this way, argumentation is (besides a distinctive dimension) also interwoven in the epistemic dimension. The main construct in our scheme is historical reasoning. Argumentation is considered to be a specific component of historical reasoning. However, historical reasoning can also reflect descriptions of the past, or changes, or explanations, which can have a function in themselves, and do not necessarily have to function as support for a claim. Furthermore, our scheme of historical reasoning also takes into account elaborative and collaborative aspects of the reasoning episodes.

In the present coding scheme historical reasoning is regarded as a subcategory of Task-related utterances. In Historical reasoning utterances the content of the historical topic is discussed. These utterances are further analyzed on an episodic level, by which several subsequent historical reasoning utterances are meant belonging to the same type of historical reasoning. It is decided to use episodes instead of utterances, for historical reasoning mostly contains more than one utterance, and elaboration and co-construction cannot be coded on the basis of a single utterance. However, for the analyses not the number of episodes is counted, but the number of utterances *within* the episodes is counted. In this way it is taken into account how many utterances are part of the episode, for the episodes can differ in length. The analysis of Historical reasoning episodes is related to the three perspectives described in Section 2.3.1: domain-specific, elaboration and co-construction. The components of historical reasoning mentioned in Section 2.1 are used with regard to the domain-specific perspective (see Table 3.3). The different components function as categories. While analyzing it seemed necessary to make two adaptations. Firstly, the category “Description” has been added, for it seemed that students sometimes described the past to each other without using one of the other categories. Secondly, the component “Historical concepts” has not been used as a single category, since using concepts is not an excluding category but can occur in all the other categories. For example, when describing a historical change concepts can be used. Therefore it is decided to code “Use of concepts” as a subdivision of

each of the other categories. For example, the category “Change” can be used with or without concepts. In addition, slight changes were made in the names of the different categories.

Table 3.3

Coding definitions of types of historical reasoning episodes

Category	Description	Example
<i>Type of historical reasoning episode</i>	<i>Content of historical reasoning episode is related to:</i>	
Time	Historical time	When was the process of depillarization?
Description	Describing the past	Nozems were boys between 16 and 18 from lower socio-economic backgrounds, who were bored and provoked the police.
Change	Describing changes or continuity	But not all youngster were carried away by rock and roll or by nozems, there were also ordinary youngsters who just married and got children.
Explanation	Giving explanations, causes and consequences	WW2 is also an important cause.
Source	Interpretation and evaluation of sources	And this historian thinks that the Sixties were revolutionary?
Standpoint	Giving a point of view and supporting this with arguments	Now I've looked at the text again, I agree that the Sixties were revolutionary.

The historical reasoning episodes were next analyzed on the appearance and type of *elaboration* (see Table 3.4). Three types of elaboration were distinguished: question, conflict and reasoning (Van Boxtel, 2000). Episodes not containing an elaboration (in the sense that a statement about a historical phenomenon was questioned, extended or criticized) were coded “No Elaboration”.

Thirdly, the *degree of co-construction* in the historical reasoning episodes was analyzed (see Table 3.5). In these analyses co-construction is used to refer to the degree both students contribute to the historical reasoning episode. Inspired by the modes of social processing of Kumpulainen and Mutanen (1999) the following distinction was made: individual reasoning, reasoning dominated by one of the students, and co-constructed reasoning, i.e., both students equally contribute to the historical reasoning episode. Based upon existing literature, it is assumed in Section 2.3.1 that interaction-action episodes reflecting historical reasoning and are elaborated as well as co-construction would especially contribute to learning. These episodes were labeled as “Co-elaborated historical reasoning”.

Table 3.4

Coding definitions of elaboration

Category	Description	Example
<i>Type of elaboration episode</i>	<i>Extended historical reasoning episode that:</i>	
Question	Starts with a question, and includes an elaborate answer	<p>0. Y wanna type in what provo is ??</p> <p>0. cause I donno.</p> <p>1. Did you know provo stopped because it got a lot of influence and the administration started listening to them, then there wasn't much left to provoke</p> <p>1. Provo was an organisation started by some type who thought not enough attention was given to the environment</p> <p>1. Finally it became a movement that like started to scatter leaflets with inciting texts on them</p> <p>1. That's how they wanted to provoke the government.</p> <p>1. To show it's authority.</p> <p>1. And so when the administration finally wanted to listen to all those people all wanting to create chaos it was no fun any more and so they stopped</p> <p>0. riiight</p> <p>0. definitely fuzzy</p> <p>1. yeah.</p>
Conflict	Starts with a negation, counter-argument or critical question, and includes argumentation	<p>0. That argument pro you just gave I didn't agree with completely</p> <p>0. During the Fifties prosperity had started to build</p> <p>0. that isn't special because of the Sixties.</p> <p>1. yes, but that is when the big changes occurred because of prosperity</p> <p>1. I could also say prosperity kept on growing</p> <p>1. leading to large reconstructions</p>
Reasoning	Starts with a statement, and includes an extension of that statement	<p>0. The industrialization and the accompanying urbanization intervned deeply in peoples' lives. Reading this you can basically say that the revolution started in the Fifties, Sixties was just the aftermath.</p>
<i>No elaboration</i>	<i>Historical reasoning episode not containing extended reasoning</i>	<p>0. I do not think the Sixties were revolutionary.</p> <p>1. okay.</p>

Inter-rater reliability for the types of historical reasoning was calculated over two randomly chosen protocols and Cohen's κ turned out to be .69. (agreement 86%). For the categories Elaboration and Co-construction inter-rater reliability was calculated over four randomly chosen protocols, and Cohen's κ turned out to be .94 (agreement 99%) and .95 (agreement 99%), consecutively. Difficulties mainly dealt with deciding when a new historical reasoning episode started, and when an episode contained two categories (for example describing a change and explaining it).

Table 3.5

Coding definitions of degree of co-construction

Category	Description	Example
<i>Degree of co-construction</i>	<i>Degree to which the episode is co-constructed:</i>	
Co-constructed	Both students equally contribute to the reasoning	<p>0. OK I think you can really say the transition from the Fifties to the Sixties was a revolution!!</p> <p>1. Yes, alright, but I think the Fifties provide kind of a prelude to the movements that originate in the Sixties...</p> <p>0. Yeah, that's true, in that case the sixtes would be plain revolutionary, and the Fifties early revolutionairy, but can we write it down like that?</p> <p>0. In te Fifties things just arrived, events that weren't really accepted then yet, but they were in the Sixties</p> <p>1. yeah you could put ut that way yeah.</p>
Dominated	One student dominates the reasoning	<p>0. Nozems are people that have a totally different opinion of the goal of life</p> <p>1. Completely different from the youth of the Fifties</p> <p>0. Right, you didn't have to work at all costs and create an ideal world around you</p> <p>0. the ideal world didn't exist anymore</p>
Individual	Only one student contributes to the reasoning	<p>0. That has also to do with those nozems because they now had money to spend the evenings in the street.</p> <p>0. Because youngsters had more money to spend, they became more independent and gained influence</p> <p>0. people with money always have influence thus politicians were forced to ...de large group of revolutionary thinking youth</p> <p>0. just an idea...</p> <p>1. yes, that's a good one</p>

3.6.2 Scoring of the texts

The collaboratively written texts can be analyzed from different perspectives and on different levels. For instance, Rouet, Marron, and Mason (1993) segmented the (historical) essays into units that were defined on the basis of their discourse function. In their framework they distinguished between Information statements (among which report statements and opinion statements) and Rhetorical adjuncts (reference and qualifier). This analysis was used to investigate students' claims and type of arguments, reference to documents, and the relation between the documents cited and the types of arguments stated (see Rouet et al., 1996). Whereas Rouet et al. (1993) focused on the argumentative structure in the essays, McCarthy Young and Leinhardt (1998) focused on the organizational structure. Based on the type of connections used, they discerned three global organization patterns: list (no

rhetorical structure), specified list (clustering of ideas), and causal (using a chain of cause-consequences). In addition they also analyzed how the documents were used in essays.

For the analyses of the text in our studies, the framework of components of historical reasoning is used. Compared to the analyses described above, more emphasis is given to the different aspects of historical reasoning and less to the argumentative or organizational structure, and to document use. Using the same framework for analyses of historical reasoning in chat dialogues and texts makes it possible to relate the aspects of the text to interaction episodes in the chat. In Table 3.6 the different items of the text analyses are described. The texts are scored on six components of historical reasoning: time references, changes and continuity, explanations, use of sources, argumentation, and the use of historical concepts. The scoring takes into account both amount and quality, for example, “number of explanations given” (item 3a), “correctness of the explanations” (item 3b), and “quality of the explanations given” (item 3c). Each item is scored on a three-point scale, including the items in which elements were counted, for example “number of time references”, “number of changes”, and “number of causes” mentioned. It might be argued that assigning the number of elements to a three-point scale implies some loss of information. However, we believed that using the actual number as a score would overemphasize the meaning of these particular items in relation to the items measuring quality. For example, when seven changes were mentioned in a text, a score of 7 would be received. This would be rather high in relation to the highest possible score (3 points) for the quality of the description of these changes. Moreover, it was considered to be less important for the overall score of the text whether for example one change more was described in the text. By assigning the numbers to scores, the importance of the items is more in balance. Based on the experiences in the first study, some changes were made in the scoring of the text. Firstly, with regard to the point of view a distinction was made between the number and quality of arguments for and against, and the quality of the final conclusion. Secondly, with regard to concepts a category was added about the use of the concept “revolution”, which can be considered to be a central concept in the task. Furthermore, a score was given for the structure of the complete essay. Consequently the maximum score changed from 42 in the first study, to 60 in the second study. The items of the text analyses as used in the second study (Chapters 5 and 6) can be found in Table 3.6 (the items of the first study are described in Chapter 4, Table 4.2).

The agreement between the two coders on ten essays was 72%, and the inter-rater reliability turned out to be .59 (Cohen’s κ). Since assessing texts is highly interpretative (Baker, 1994), this outcome is considered to be sufficient. It seemed that especially the scoring of the quality items caused difficulties. Therefore, it was decided to have each text scored by the two coders, after which the scoring was compared and differences discussed until agreement was reached.

Table 3.6

Items of text analysis and scoring

Aspects	Items of text analyses	Scoring
1. Time	a. Number of time references	0 = 0 ; 1 = 1-9; 2 = 10-19; 3 = ≥ 20
	b. Correctness	1 – 3
2. Change	a. Number of changes	0 = 0; 1 = 1-3; 2 = 4-5 ; 3 = ≥ 6
	b. Correctness	1 – 3
	c. Quality description changes	1 – 3
3. Explanation	a. Number of causes	0 = 0; 1 = 1-3; 2 = 4-5; 3 = ≥ 6
	b. Correctness	1 – 3
	c. Quality description causes	1 – 3
4. Sources	a. Use of own words in describing information from the sources	1 – 3
	b. Distinction between different historical interpretations	1 – 3
5. Point of view	Number of arguments for	0 = 0; 1 = 1; 2 = 2; 3 = 3
	Quality arguments for	1 – 3
	Number of arguments against	0 = 0; 1 = 1; 2 = 2; 3 = 3
	Quality arguments contra	1 – 3
6. Concepts	Quality final conclusion	1 – 3
	Number of substantive concepts	0 = 0; 1 = 1-14; 2 = 15-19; 3 = ≥ 20
	Correctness substantive concepts	1 – 3
	Number of methodological concepts	0 = 0; 1 = 1-4; 2 = 5-6; 3 = ≥ 7
7. Structure text	Quality of the use of the concept 'revolution'	1 – 3
	Quality structure text	1 – 3

3.6.3 Pretest and post-test

One of the points of interest of this research is whether individual students learned about the particular topic from the collaborative writing task, and whether these learning outcomes differed for the conditions. Hence, both a pretest and a post-test were administered to indicate individual learning outcomes (see Appendix B). Since the aim of the task was to improve subject-matter knowledge, the pretest and post-test focused on subject knowledge about the 1960's instead of on students' historical reasoning skills. Since it was assumed that the active use of historical information while reasoning contributes to learning, the aim was to test students' knowledge about the subject at hand. The components of historical reasoning are used for the construction of test items, for instance describing changes in the 1960's, giving causes for these changes, and explaining concepts (see Table 3.7). The test contained seven open-answer questions and one multiple-choice question. The maximum score on both tests was 79. The pretest and the post-test consisted of the same questions; however, for some items different historical sources (for example a different picture or text) were used. Moreover, the items in the pretest and post-test were ordered differently. To prevent influence of the order of the questions (the so-called learning effect of the test), two versions of the test were used in which the

items were ordered differently. Within one condition both versions were administered. So, within one condition students made either version A or B of the pretest, and dependent on the version of the pretest, the other version of the post-test (so pretest version A, post-test version B, and vice versa).

The inter-rater reliability of the scoring, on ten randomly chosen tests, varied between .70 and 1.00 (Cohen's κ). For the study reported in Chapter 6 item homogeneity was calculated. After excluding item 1a, in which the students had to give associations with the Fifties, the item homogeneity (Cronbach's α) turned out to be acceptable (pretest .72; post-test .64).

Table 3.7

Description of the items of the pretest and post-test and the maximum scores

Item	Description	Components historical reasoning	Maximum score
1a	Associations 1950's ^a	-	
	-amount		3
	-variation		2
	-description		2
1b	Associations 1960's ^a		
	-amount		3
	-variation		2
	-description		2
2	Situating historical phenomena in time ^b	Time	10
3	Giving a definition of four concepts	Concepts	8
4	Giving examples of four concepts	Concepts	8
5a	Giving characteristics of youths in the Fifties	Changes	4
5b	Describing changes in the behavior of youths in the 1960's		4
6a	Giving causes for the changes in the behavior of youths in the 1960's	Explanation	10
6b	Indicating the most important cause		2
7a	Giving arguments pro the given statement	Viewpoint	6
7b	Giving arguments contra the given statement		6
8a	Interpretation of a source	Source	2
8b	Interpretation of a source		2
8c	Evaluating the trustworthiness of both sources		3

^a Association item: item in which students are asked to give associations with the 1950's and 1960's in a mind map.

^b Multiple-choice items. The answers were correct or false.

3.6.4 Scoring of the External Representations

The external representations the students produced in the experimental conditions were scored on the number of arguments for and against represented. The inter-rater reliability (Cohen's κ) over 12 randomly chosen representations was .89 for the arguments pro and .78 for the arguments contra. The number of sources referred to in the representation, the total number of arguments used (arguments for plus arguments against) and the balance of arguments for and against were also included in the

analyses. The balance refers to the difference between the number of arguments pro and the arguments contra. A higher score on this measure means less balance. It should be noted that on the basis of the sources provided, more arguments pro could be identified than arguments contra. In sum, sixteen arguments pro could be identified from the sources and ten arguments contra.

3.6.5 Statistical analyses

In order to test differences between the conditions, both univariate and multivariate analyses of variance were carried out. Detailed descriptions of the statistical analyses we used can be found in the following chapters.

CHAPTER 4 HISTORICAL REASONING IN A COMPUTER SUPPORTED COLLABORATIVE LEARNING ENVIRONMENT¹

4.1 Introduction

A computer-supported collaborative learning (CSCL) environment is a learning environment in which a large amount of information can be accessed easily, and in which knowledge can be shared and co-constructed through communication and joint construction of products. It is believed that these characteristics make CSCL an environment with potential to provoke and support the construction of knowledge (Lethinen, Hakkarainen, Lipponen, Rahikainen, & Muukonen, 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, Erkens, Schmidt, & Renshaw, 2000). This relationship can be studied by taking into consideration the specific characteristics of the domain of study and the co-constructed nature of knowledge.

The main focus of the research described in this chapter is the domain-specific content of the student interaction in a CSCL environment. We are especially interested in the domain of history and more specifically on 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 with which historical phenomena can be described and explained.

Another, and complementary, way to study the relationship between student interaction and meaningful learning is to put into focus the co-construction of knowledge. In recent years, especially from a sociocultural perspective on learning, the joint and situated construction of meaning through communication and the role of mediational tools have been emphasized. When students work on a common task, mutual understanding must be created and sustained continuously (Roschelle, 1992). Research has shown that the need to coordinate activities can provoke valuable learning processes. Knowledge can be co-constructed through the integration of ideas or through productive argument, questioning, and exploration. Several researchers showed the importance of asking and answering of questions (e.g., King, 1990; Webb, 1991) and argumentation to resolve controversy (e.g., Brown & Palincsar, 1989; Dillenbourg, Baker, Blaye, & O'Malley, 1995). Furthermore, student interactions can differ from each other in the amount of co-construction. A student interaction in which one of the

¹ Van Drie, J., Van Boxtel, C., & Van der Linden, J. (2006). Historical reasoning in a computer-supported collaborative learning environment. In A. M. O'Donnell, C. E. Hmelo, & G. Erkens (Eds.), *Collaborative learning, reasoning, and technology* (pp. 265-296). Mahwah, NJ: Lawrence Erlbaum.

students is dominating, or that shows unproductive dispute or the accumulation of ideas without critical challenges, is not believed to be valuable for learning (Mercer, 1995).

How can we elicit student interaction that reflects historical reasoning and co-construction in a CSCL-environment? 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; Palinscar & Herrenkohl, 1999; Van Boxtel, 2000). We focus in this chapter on the design of the task. We present a small-scale study in which we compared the interaction of students working together on different historical inquiry tasks. In our study we distinguish effects with and effects of computer-supported collaborative learning (Salomon & Perkins, 1998). The effects *with* are to be found in the interaction between the students during the accomplishment of the task. The effects *of* are to be found in the residues of the collaborative activity, such as the group product that is jointly constructed and the individual learning outcomes that are reflected in the participation of students in new situations. Lethinen, et al., (2001) stated that until now research on CSCL hardly focuses on learning outcomes.

Next, we first elaborate on the term historical reasoning. Second, we discuss the potential of inquiry tasks to provoke and support collaborative historical reasoning. Then we describe the method of our study and the instruments we used to analyze the quality of the student interactions and the learning outcomes. The results section contains the results of the analyses of the student interaction, the quality of the group products, and the individual learning outcomes. Finally, we summarize our findings and make some recommendations for future research, especially about tools that might be helpful in supporting historical reasoning.

4.2 Historical reasoning

The research project described in this chapter focuses on the domain of history in upper secondary education. Different concepts are used to describe the aim of history education. Perfetti, Britt, and Georgi (1995) and Roderigo (1994) used the term *historical literacy*, whereas Spoehr & Spoehr (1994) and Husbands (1996) used the term *historical thinking* and others used the term *historical consciousness* (e.g., Goegebeur, Simon, de Keyser, van Dooren, & van Landegem, 1999; Jeismann, 1997, Von Borries, 1997), or *historical reasoning* (Kuhn, Weinstock, & Flaton, 1994; Leinhardt, Stainton, & Virji, 1994). The terms historical literacy and historical consciousness refer to a more general ability and attitude, whereas the terms historical thinking and historical reasoning stress the actual activity of the students. In this research project we use the term *historical reasoning*. We prefer this term for it stresses the activity of students: Students not only have to acquire knowledge of the past, but they have to use this knowledge while interpreting phenomena from the past and the present. Moreover, it refers to verbally explicated reasoning, in speech or in writing. Historical reasoning can thus be seen as the activity of students by which historical consciousness is expressed. Moreover,

the active role of students is in line with (socio-) constructivist theories about learning, which argue that knowledge is not transmitted or passively received, but actively constructed (Brown, Collins, & Duguid, 1989; Duffy & Jonassen, 1992) and mediated by the use of language and tools (Wertsch, 1991). Especially in history education, a long, strong tradition of transmitting historical knowledge exists.

We define historical reasoning as describing, explaining, or judging phenomena of the past with the use of historical concepts. Using historical concepts is important, because an important goal in history education is that students can use 'the language of history'. We distinguish six aspects of historical reasoning, on which we elaborate next.

4.2.1 Situating historical phenomena in time

History education aims at the development of the ability to create a historical context to interpret traces of the past or contemporary phenomena. Setting phenomena into an historical context requires that students have an idea of when certain phenomena took place and in which chronological order. This chronological order of events is also important in order to discern aspects of change and continuity and to explain historical events. Furthermore, it requires that they can use the language of time, such as dates, centuries, and names of periods (e.g., Antiquity, Middle Ages, and modern times). Students must learn to think about the past from the perspective of the past itself, and not to judge past actors solely by present standards. The failure to grasp the nature of historical context is an important source of pupil misunderstanding (Husbands, 1996). Although not perfectly possible, empathy, role taking, and the change of perspective within a distant time frame are essential in history education. In addition, the practice of contextualized thinking is not only important in history education; it also helps to understand people different from us or people in different situations in our own time.

4.2.2 Describing phenomena from the past

History deals with events, structures, developments, and persons in the past. An important aspect of historical reasoning is the description of phenomena from the past. History education aims at the construction of images and descriptions of the past that are carefully grounded in reliable traces of the past, such as documents, pictures, artefacts, and oral accounts. In history lessons new images are constructed and existing images are transformed.

History has its own language to describe phenomena. Some concepts are drawn from other disciplines, whereas others are more specific to the study of history, or used in everyday life. Historical phenomena are described and analysed with concepts from several disciplines, such as sociology, anthropology, philosophy, economics, and politics (e.g., class, democracy, parliament, capitalism). The concepts that are drawn from other disciplines are mostly used within the context of different themes of the history curriculum and also in the curriculum of other subjects, such as geography and economics. Although most of these concepts are very abstract, the fact that students

come across the terms more than once may stimulate students to give meaning to the concepts. Some historical concepts are specific and limited to a specific historical period and students come across them only a couple of times (e.g., feudalism and pharaoh). History thus uses many concepts that are not known by students and that are difficult to learn because there is only a limited opportunity to give meaning to the concepts.

Some historical concepts are the product of historians and not known by students, whereas others are grounded and used in every day life. Problems may arise, however, because although the students are familiar with the term of the concept, the term may refer to a different phenomenon. Our present world differs from the world of the past. Church in the Middle Ages is something different than a church in our present Western society and trade in Antiquity differs from trade in our present time. Students must learn to describe an unknown reality with known terms. Students often interpret a concept on the basis of their knowledge of the present time. Misunderstanding through anachronism can easily develop. Students must differentiate between the present meaning of concepts and the meaning of concepts used in a specific historical context (Voss & Carretero, 1994).

4.2.3 Describing change and continuity

A very central aspect of historical reasoning is the recognition and description of processes of change, such as the spread of Christianity, the collapse of the communist system in Russia, or the emancipation of women. According to Stearns (1998) the main purpose of history is to understand the phenomenon of change over time. Historical change is a multifaceted subject. It can occur in very different areas of society, such as political systems, technologies, fundamental beliefs, and family life. Historians often make a distinction between political, economical, social, and cultural changes. Studying historical changes raises not only the question of what changed, but also what stayed the same and what caused the change (see the next section). Focus on continuity helps to interpret the historical change: to see what the impact of the change is, and how the change came about (e.g., suddenly, gradually, or more long term). For students it is important to realize that it is not a matter of black and white. During a change other aspects of society can stay the same. Historical change and continuity can occur at the same time. In studying information about the past, students have to be able to recognize aspects of change and continuity and to use historical lexicon and analytical tools to describe changes.

4.2.4 Explaining historical phenomena

In reasoning about historical phenomena, explaining the phenomena by searching for causes and consequences is important. The study of causality within the domain of history has been both important and controversial (Voss, Ciarrochi, & Carretero, 1998). It has been important because ascertaining how antecedent conditions possibly play a role in producing historical events presumably adds to our understanding of history. It has been controversial because causation in history does not involve simple cause-effect relationships. Instead, there are many actions and events that occur over

time, which may play a role in producing historical events. Furthermore, a distinction can be made between immediate and long-term causes, and between manifest events and latent events (i.e. long-term developments), such as population shift or climate change (Spoehr & Spoehr, 1994). So, a historical event cannot be explained by one single cause: Political and economical causes, personal motives, and acting, interact with each other in a complex way.

Jacott, López-Manjón, and Carretero (1998) mention two different theoretical models of explanation in history. The intentionalist model conceptualizes historical explanation basically in terms of human actions, attributing a great importance to the particular motives, intentions, and beliefs of the agents involved. The structural model of explanation is based on the relationship between a set of conditions (e.g., economic, demographic, social, political, religious, etc.) that constitute social reality. Results from several studies show that students tend to explain historical events from the intentionalist, personalistic point of view (Carretero, Jacott, López-Manjón, & León, 1994; Halldén, 1986, Voss, Carretero, Kennet, & Ney Silfies, 1994). In a study conducted by Carretero, López-Manjón, and Jacott (1997) novice and experts were asked to explain four historical events by ranking six different type of causes in order of importance (political, economic, ideological, personalistic, remote, and international policy). The results showed that nonexperts attributed greater importance to personalistic causes. Experts tend to vary the importance given to different causes according to the historical event in question. They do not attribute the same influence to political, economic, ideological, and other causes, but consider each event in its own context.

4.2.5 *Taking into account the trustworthiness of sources*

Information about the past is acquired by very different historical sources, such as all kinds of written documents, images, and objects. Historical sources often contain complementary, but also contradicting information about historical phenomena. Therefore, students cannot simply combine the contents of several documents into a single representation (Rouet, Britt, Mason, & Perfetti, 1996; Wineburg 1991a). They first have to recognize the conflict and then compare and weigh the different accounts and their specific arguments. In this process they should

- Carefully select information.
- Evaluate this information in the context of who wrote it and for what purpose.
- Determine how the document relates to other documents.
- Coordinate and resolve inconsistencies.

This requires that a student must acquire specific knowledge about document characteristics and methods to evaluate the trustworthiness of sources. Adequate reasoning with and about documents is especially important for writing an argumentative essay. In an argumentative essay students have to present a personal point of view on a certain historical issue which is based on information from and the trustworthiness of the different historical sources.

4.2.6 Take a personal point of view and support this with arguments

In reasoning about history problems students are also asked to evaluate past phenomena, acts of persons, and sources. Presenting an own point of view on a historical issue is more than giving just an opinion. The implication of that would be that one opinion is as good as the other and that grading such opinions is a purely subjective exercise. Within history an opinion can be viewed as an expression of historical reasoning and this is only as good as the evidence and arguments used to support this opinion (Spoehr & Spoehr, 1994). We therefore prefer to use the term personal point of view, instead of opinion. A coherent description of phenomena and taking into account the historical context, the possibility of multicausation and the trustworthiness of sources all contribute to the construction of a convincing argumentation of that point of view.

Finally, we have to take into consideration that reasoning about history in the way described above is difficult, especially for students in secondary education. According to Spoehr & Spoehr (1994) the hardest part of historical thinking and reasoning is learning to anticipate counterarguments, to weigh alternate explanations for the phenomena being explained, and to be able to explain why one interpretation seems preferable to others.

4.2.7 The social and situated nature of historical reasoning

The study of history is an ongoing discourse about the interpretation of the past. Tools such as concepts, traces of the past, narratives, and analytical schemes that are provided by the cultural, historical, and institutional settings in which students participate and that are available in a specific situation always mediate historical representations. Historical reasoning is a social activity, although it can take place in situations with more or less interaction. Reasoning that is mediated by social interaction occurs in a situation in which agents shape each other's actions through verbal or computer-mediated, spoken, or written communication. Especially collaborative reasoning within the domain of history may contribute positively to the competency of historical reasoning, as it can provide students with the opportunity to discuss historical phenomena, concepts, and sources.

4.3 Historical inquiry tasks

In an inquiry task students have the opportunity to construct their own knowledge, with the assistance of others and with the available mediational means. We confine ourselves to historical inquiry tasks in which the students, in pairs, write a text based upon the study of several historical sources. Although writing tasks are regularly used in history education, collaborative writing does not often occur. As stated earlier, we believe collaborative learning to be a powerful means to enhance reasoning about historical issues. The main advantage of collaborative writing, compared to individual writing, is the possibility of receiving and giving immediate feedback (Giroud, 1999). The discussions generated by

the writing task make the collaborators verbalize and negotiate many things, such as representations, purposes, concepts, arguments, text structure, plans, and doubts. This may lead to increased awareness of and more conscious control over the writing and learning processes (Gere & Stevens, 1989; Giroud, 1999).

Research has shown that the study of multiple historical sources in order to write a text can result in a deep understanding of historical phenomena (Perfetti, et al., 1995; Rouet, et al., (1996); Voss & Wiley, 1997; Wiley & Voss, 1996). In a study on developing understanding while writing essays in history, Voss and Wiley (1997) compared the writing of three kinds of texts: a narrative, a history, and an argumentative essay. They concluded that students who wrote an argumentative essay are likely to construct more causal models than students who wrote a narrative or a history and that writing an argumentative essay enables more knowledge transformation. In addition to this research, we were interested in the effect of several types of inquiry questions. Within the domain of history three types of inquiry questions can be distinguished: descriptive, explanatory, and evaluative questions. For example, we can ask the question of what kind of weapons were used during World War I (descriptive), what can be considered causes of World War I (explanatory), or whether only Germany can be blamed for the war (evaluative). Describing, explaining, and evaluating are important aspects of historical reasoning. It is likely, however, that students who try to answer a descriptive question do not spontaneously discuss explanations or give their own viewpoint. Explaining and evaluating, on the other hand, both require a description of what is explained or evaluated. In a pilot study (Van Drie, 2000) in which students had to explain the American fear for communism in the 1950's, we saw that especially when the students discussed which cause was most important (which is an evaluation) historical reasoning occurred. Evaluating historical phenomena seems to enhance a more thorough way of historical reasoning, because it requires deep understanding, a clear description of what has to be evaluated, and adequate argumentation.

The purpose of the study presented here was to investigate the influence of the type of inquiry question on the interaction between students and on the learning results. We compared two types of inquiry questions: an explanatory question and an evaluative question. We expected that the type of inquiry question would affect the way in which students reason about history. Students in the explanatory condition were expected to talk more about explanations than the students in the evaluative condition. The students in the evaluative condition were expected to talk more about their opinion and supporting arguments than the students in the explanatory condition, but not at the cost of describing and situate phenomena in time, because those forms of historical reasoning are needed to formulate and support a viewpoint. Furthermore, we expected that more historical reasoning and a more thorough way of historical reasoning in the evaluative condition would also be reflected in better learning outcomes.

4.4 Method

The aim of this study was threefold: first, to investigate what kind of student interaction is provoked by a historical inquiry task in a CSCL environment; second, to get more insight into whether the type of inquiry task (explanatory vs. evaluative) affects the quality of the interaction and learning; and third, what kinds of problems students face while performing the task at hand. The outcomes on these questions will form the basis for follow-up studies in which we will compare different tools for supporting historical reasoning in a CSCL environment. Before we can design supporting tools we first have to gain insight into the quality of students' reasoning about history. In the next section we first describe the learning environment and task we used and second the design of the study.

4.4.1 *Learning environment and task*

The students worked in a computer-supported learning environment for collaborative text writing: TC3. This name stands for: Text Composer, Computer Supported, and Collaborative (see Erkens, Prangma, & Jaspers, chap. 10, in this volume). Students work one to a computer, physically separated from their partner. They communicate by means of a chat facility, and a shared text, which they can edit through taking turns. In addition to these communicative facilities, they each have access to a private notepad and to different information sources. The students were presented with a historical inquiry task, which involved studying historical sources and writing a text of approximately 750 words on a given question. Students were given a 5-hour maximum for work on the task. For this research project a task was constructed concerning changes in the behavior of the Dutch youth in the 1950's and 1960's. Different types of sources were used, such as descriptive texts from textbooks, interpretations of historians, photos, tables, and interviews. The sources were divided between the two collaborating students, so they each had different sources. For both the students two texts were added with general information about the 1960's. The task was improved through the comments of two experts on history education and the comments and the performances of two first-year social science students who had accomplished the task. The topic of the task was only familiar to the students in a general way; they did not receive any instruction about the topic in advance.

4.4.2 *Design*

Subjects of the study were 20 students from a history class in upper secondary education at pre-university level (16, 17 years of age). The students worked in 10 randomly assigned pairs. The students had some experience with historical inquiry tasks and with collaborative learning. The pairs were randomly assigned to one of the two conditions, five pairs in each condition. In the explanatory condition, students were asked to explain the changes in behavior of the youth in the 1950's and the 1960's. In the evaluation condition, they were asked to judge whether the changes in behavior of the

youth in these years were revolutionary or not. Five dyads worked in the explanatory condition and five dyads in the evaluative condition.

Considering the interaction process we expected differences in how the students reasoned about history. The explanatory condition was expected to contain more interaction about explanations, whereas the evaluation condition was expected to contain more interaction on taking a point of view and arguments to support their viewpoint. We expected the same amount of interaction for both condition on the following aspects: situating in time, description, changes, and evaluation of sources. Furthermore, we did not expect any differences in the task focus, nor in the amount of co-construction. On the level of texts, we hypothesized that the texts in the explanatory condition would contain more explanations but a less explicit viewpoint as the evaluative texts. The texts in the evaluation condition were expected to contain as much description of change and continuity as the texts in the explanatory condition but fewer explanations. Finally, we expected more individual learning gains in the evaluation condition, because in this condition the students participated in a more thorough way of historical reasoning.

4.5 Analyses

4.5.1 Interaction Analyses

In order to analyse the interaction processes we used Multiple Episode Protocol Analysis (MEPA); see <http://edugate.fss.uu.nl/mepa>). MEPA offers a flexible environment for the qualitative and quantitative analysis of collaborative dialogue protocols. The interaction in the chat protocols was coded on the level of utterances. The chat protocols were analyzed on three dimensions: task acts, historical reasoning, and co-construction. Furthermore, we analyzed the use of historical concepts in historical reasoning.

First, utterances were coded on the dimension of task acts, which are described in Table 4.1. Five main categories were distinguished: utterances related to the content of the task at hand (coded task) and to procedures to perform the task (coded 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, which are also described in Table 4.1. Interrater agreement was satisfactory and ranged between .77 and .85 (Cohen's κ).

Table 4.1

Coding definitions Task acts

Category	Description and examples
1. Task	1. Expressions concerning the content of the task
1.1 Historical reasoning	1.1. Discussion of the historical content of the task, including the content of the historical sources. -Do you know when depillarization started? -I think the sixties were revolutionary, because a lot changed during that period.
1.2. Text construction	1.2 Concerning the construction and structure of the text -Shall we start with an introduction, followed by a paragraph about the changes in the sixties?
1.3. Text revision	1.3. Discussion of revision or addition of specific text -We need to add something about the influence of TV in this part. -We have written twice about the influence of Provo, we should delete one of them.
1.4. Goal	1.4. Concerning verification of meeting task demands -We should state something about the changes in the behavior of the youth, for that was the task.
1.5. Information	1.5. Concerning the use of the information sources (not discussing the content of the source) -I have an interesting source about Provo. -How many sources do you have?
1.6. Evaluation	1.6. Evaluating the content of the task, the tool, or the text -This task is difficult! -The conclusion is badly written.
1.7. Word-count	1.7. Concerning checking the number of words written -We already have 700 words. -Still 150 words to go.
2. Procedure	2. Expressions concerning the organization and planning of the task.
2.1 Approach	2.1 Concerning the general approach of the task -Shall we discuss how to approach the task? -Shall we divide the sources?
2.2 Evaluation	2.2. Concerning the evaluation of the task-approach or organization (not an evaluation of the task, or the written product) -I enjoyed working with you. -We made a good task planning.
2.3. Turn-taking	2.3. Coordination of turn taking -Do you want to write? -Shall I continue writing?
2.4 Coordination	2.4. Concerning coordination of actions -What are you doing at the moment? -I'm writing some notes -Have you read the text yet?
2.5 Planning	2.5. Concerning coordination of time -We should start writing the text tomorrow. -We have three lessons to finish this assignment.
3. Program	3. About technical aspects and program-related matters -How can you copy from the notes? -How can I let you write?
4. Social	4. Concerning topics not related to the task or the program, but with a social function -Did you see that movie on TV last night? -Can you say hello to Astrid?
5. Greetings	5. Greetings at the beginning or end of a working session. -Hi Monique, how are you today? -We have to stop now, see you tomorrow.

Second, the utterances coded in the first step as historical reasoning were analyzed in more detail, for we were especially interested in which way students reasoned about history. Based on the earlier description of aspects of historical reasoning, we discerned six aspects: (a) situating historical phenomena in time, (b) describing the past, (c) describing changes and continuity, (d) explaining the past, (e) discussing the trustworthiness of the source, and (f) presenting a viewpoint and supporting this with argumentation. Because using domain-specific concepts is important for the quality of reasoning, we made for each of the six categories a distinction in two subcategories: using historical concepts and without using historical concepts. However, this distinction does not give any information on which concepts are used. We selected six concepts, which we thought to be central to the subject studied, and counted how often these were used in the chat protocols. The selected concepts were:

1. Democratization: Process in the 1960's in which the society became more democratic, as the people demanded more direct participation in politics, companies, organizations, schools, and so on.
2. Individualization: Development in Dutch society in the 1960's, in which the interests of individual people became more central and people became more focused on individual rights and needs.
3. Nozem: Name for a subgroup of young people in the 1950's, mostly from the working class, who were hanging around the streets and loved rock and roll, motorbikes, and so on.
4. Provo: Movement of young people who wanted to discuss the welfare society and provoked the authorities through all kinds of playful actions. They were mainly centered in Amsterdam.
5. Depillarization: In the first half of the twentieth century Dutch society was strictly divided in socioreligious groups (Protestants, Catholics, Socialists, and Liberalists), which are referred to by the term pillarization, or compartmentalization. In the 1950's and 1960's this system broke down by processes such as individualization, democratization, and secularization. This process is called depillarization.
6. Second Women Liberation Movement: Second wave of the women liberation movement, which took place in the 1960's and 1970's (the first wave was around 1900 and focused mainly on the right to vote).

Inter-rater reliability between two judges was measured over two randomly chosen chat protocols (in total 343 utterances) and reached .69 (Cohen's κ).

Third, to measure degrees of co-construction while reasoning historically, we focused on the extend to which students reasoned together and build on each other's contributions (Kumpulainen & Mutanen, 1999; Van Boxtel, 2000). We first divided the historical reasoning utterances in episodes.

An episode is defined as meaningful sequence of utterances about one of the six aspects of historical reasoning; such as an episode consisting of eight utterances in which the students discuss one of the causes of the changes in the behavior of the youth. For each episode we decided to what degree it reflected co-constructed reasoning. We considered episodes as co-constructed reasoning, when both participants equally contribute to the reasoning. Furthermore, we distinguished the category individual reasoning, in which only one participant contributes, and dominated reasoning in which one student dominates the reasoning and the other only gives a small contribution. For the analyses of this aspect we did not count the number of episodes, but instead, we measured the number of utterances within the episodes. In this way it is taken into account how many utterances are part of the episode, for the episodes differ in length. Interrater reliability on four randomly chosen protocols (112 episodes) reached .95 (Cohen's κ).

4.5.2 *Text analyses*

The collaboratively written texts were scored on six aspects of historical reasoning. In Table 4.2 the different items of the text analyses are described. Compared to the aspects mentioned earlier, we did not use the aspect description of the past, for it proved to be hardly possible to distinguish this aspect in the text from the other aspects. Instead we decided to add the use of historical concepts as one of the items. On each aspect of historical reasoning two or three items were constructed, focusing both on amount and quality. Each item was scored on a scale from 1 to 3. Two judges independently scored the texts. Initially, the proportion of agreement on ten texts was 59%, which we considered agreeable for assessing texts is highly interpretative. The scores were subsequently discussed until agreement was reached between both judges.

4.5.3 *Pretest and post-test*

The pretest and the posttest consisted of eight items. In the items, different aspects of historical reasoning are reflected. The questions of the pretest and the post-tests were the same; we only used different historical sources (e.g., a different picture or source). The reliability of the eight posttest items is .73 (Chronbach's alpha), which is satisfactory for the a test with open questions. Two judges scored the tests. The interrater reliability, on 10 randomly chosen pretests and 10 posttests, varied between .62 and .94 (Cohen's κ). Table 4.3 summarizes detailed information of the test at item level.

Table 4.2

Items of text analyses

Aspects of historical reasoning	Items of text analyses
1. Time	1.1 How many time references are given? 1.2 Are the time references correct?
2. Change	2.1 How many changes are mentioned? 2.2 Are the changes described correctly? 2.3 Is a differentiation in changes given (i.e. continuity, impact of the change, suddenly, gradually, etc.)?
3. Explanation	3.1 How many explanations are given? 3.2 Are the causes described correctly? 3.3 Is a distinction made between the impacts of the different causes?
4. Sources	4.1 Did the students use their own words for describing information of the sources? 4.2 Is a distinction made between different historical interpretations?
5. Point of view	5.1 Does the text give a clearly formulated point of view, which includes argumentation? 5.2 What is the quality of the argumentation?
6. Concepts	6.1 How many different historical concepts are explicitly used? 6.2 Are the concepts correctly used? 6.3 How many different methodological concepts are explicitly used (i.e. causes, change, trustworthiness, etc.)?

Table 4.3

Description, maximum score, agreement and inter rater reliability of items in the pre- and post-test

Question	Descriptions of the items	Aspect of historical reasoning	Maximum score	Inter-rater agreement in %	Cohen's κ
1	association task*	concepts	16	85	.84
2	situating historical phenomena in time	time	10	- **	- **
3	situating photos in time	time	10	90	.89
4	describing changes in the fifties and sixties	change	6	95	.94
5	giving causes for the changes	explanation	12	70	.62
6a	selecting information from a source	source	2	80	.70
6b	evaluating trustworthiness of a source	source	2	85	.78
7	taking and argumenting a point of view	viewpoint	4	80	.76
8	giving descriptions of six concepts	concepts	12	82	.72

* Association task: task in which students are asked to give associations on the fifties and the sixties in a mind map.

** Multiple-choice items. The answers were correct or false.

4.6 Results

The results of the analyzes are described in this section. First, we discuss the results on the interaction process in the chat protocols, after which we discuss the results on the texts written and the individual learning outcomes. In the description of the results we compare the two conditions: the explanatory inquiry task and the evaluative task. Comparison between the two groups on the results of the pretest showed no difference in scores, $t(18) = .35$; $p = .73$.

4.6.1 Interaction processes in the chat

Task acts

Students performed different activities within the learning environment, for example reading sources, writing the text, writing notes and chatting. The mean length of the chat was 572 utterances ($SD = 274.53$). As described earlier, we analyzed the chat protocols on different dimensions. The chat protocols were first analyzed on the level of task acts, which gives information about what kind of chat discussions were provoked by the given inquiry task. Table 4.4 shows the mean frequencies and the percentages of the task acts discussed in the chat protocols. From this table we can conclude that the students' work focused on the task. About 72% of the utterances were directly related to the task, of which 32% was about procedures and 40% about the task itself. The chat was often used to coordinate the activities: About 20% of the utterances were related to this aspect. About 13% of the utterances contained historical reasoning. As the high standard deviations show, the chat discussions differed a lot among the pairs; especially the amount of social talk: from 4% to 40%.

Table 4.4

Mean frequencies, standard deviations and mean percentages and standard deviations of task acts in the chat protocols ($N = 10$)

Task acts	Frequencies		Percentages	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Task	206.50	76.14	39.28	11.77
historical reasoning	61.10	36.41	13.42	9.50
text construction	25.40	11.43	4.76	2.11
revision	51.90	36.30	9.03	4.40
goal	11.70	6.27	2.32	1.35
info	13.20	10.04	2.09	1.34
evaluation	21.60	10.07	4.10	1.61
word count	21.40	14.42	3.55	2.15
Procedure	179.50	77.30	32.77	7.51
coordination	115.10	57.28	20.60	6.40
task approach	10.70	7.29	2.35	1.88
planning	15.60	8.88	3.45	3.31
turn taking	27.30	27.86	4.24	2.51
evaluation	11.30	7.83	2.21	1.36

Program	31.90	25.05	5.24	3.12
Social	117.50	134.43	16.22	12.72
Greetings	35.40	18.10	6.30	1.37
No Code	.70	1.89	.20	.42
<i>Total utterances</i>	<i>572</i>	<i>274.53</i>		

Historical reasoning

Second, we were interested in how students reasoned about history, and whether and how there were differences between the students who worked on the explanatory question and on the evaluative question. We therefore analyzed the utterances coded as historical reasoning in more detail. We discerned six aspects of historical reasoning and also coded whether historical concepts were used in the reasoning. The results are presented in Table 4.5.

Table 4.5

Mean frequencies and standard deviations for aspects of historical reasoning for the two conditions (N = 10)

Aspects of historical reasoning	Explanatory question		Evaluative question		<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Time	3.60	4.93	6.60	5.37	.38
Concepts	3.00	4.24	3.20	3.42	.94
No concepts	.60	1.34	3.40	3.29	.14
Description	6.20	4.21	20.00	20.46	.18
Concepts	4.00	2.35	11.80	9.50	.14
No concepts	2.20	2.95	8.20	13.44	.36
Change	11.20	7.29	14.60	11.74	.60
Concepts	6.60	6.27	6.40	4.62	.96
No concepts	4.60	6.69	8.20	9.42	.51
Explanation	12.20	6.61	1.00	1.41	.02*
Concepts	7.80	6.02	.80	1.30	.04*
No concepts	4.40	1.82	.20	.45	.00*
Source	7.00	4.30	8.20	8.23	.78
Concepts	2.20	2.17	2.80	4.76	.80
No concepts	4.80	3.96	5.40	4.04	.82
Viewpoint	.20	.45	31.60	14.76	.01*
Concepts	.20	.45	29.60	14.21	.01*
No concepts	.00	.00	2.00	3.08	.22

* $p \leq .05$

Table 4.5 shows that all aspects of historical reasoning occurred in the chat while performing this inquiry task. However, additional analyses showed that not all types of reasoning were used by all 10 dyads; the chat-protocol of only one dyad showed all types of reasoning. Almost all dyads gave descriptions of the past, talked about the changes that occurred in the 1960's, and discussed the historical sources, although on a small scale. Six dyads talked about the aspect situating in time. The aspects explanation and point of view did also not occur in all the chats. The students who worked on the explanatory question talked a lot about explanations, whereas the students who worked on the evaluative question frequently discussed their point of view. A t test for independent samples showed that the difference on the amount of talk about explanations was significant, $t(8) = 3.71; p \leq .05$, as was the difference on the amount of talk about viewpoint $t(8) = 4.75; p \leq .01$. So, as we expected, the students who had to explain the changes of the youth in the 1960's, talked significantly more about explanations and the students who had to evaluate whether the changes were revolutionary or not discussed significantly more about their viewpoint. This latter type of talk did not go at the expense of other types of reasoning because the students in the evaluation condition talked as much about change as the students in the explanatory condition. For the other aspects of historical reasoning no differences were found.

Furthermore, we analyzed whether and how students used historical concepts when constructing historical reasoning. Historical concepts were used most of the time, except when they discussed and evaluated the historical sources. The episodes in which students discussed their point of view almost always contained historical concepts. Additional analyses focused on the use of the six concepts that were considered central to the subject of the task, which were democratization, individualization, nozem, Provo, depillarization, and second women liberation movement. The concepts nozem and Provo were most frequently used and were also used by almost all dyads. Most of the dyads did not explicitly use the concepts democratization, individualization, and second women liberation movement at all. Most often the concepts were used in an implicit way, only occasionally, the meaning of a concept was explicitly explained. We provide an example of both occasions. In the first example, Astrid and Mark discuss the meaning of the concept nozem. The first part of this fragment took place after 52 minutes, the second part after 1 hour and 17 minutes.

In the first part of Excerpt 1, Astrid asks what a nozem is. Mark uses his own prior-knowledge to explain the concept and refers to a novel he has read. Although he says he is not quite sure, Astrid accepts the explanation. They do not search the sources to find a better description. After some time, Mark does not feel sure about the meaning of the concept nozem and asks Astrid. In the mean time, Astrid has read about nozems and is able to provide a more elaborate description. Astrid and Mark explicitly discuss the meaning of the concept.

Excerpt 1

An example of discussing the meaning of historical concepts

- 1 Astrid *Do you know what a nozem is?*
 2 Mark *I have seen the word in the novel "Ik, Jan Cremer". I think it is a sort of nerd or loser, but I am not sure. It was also used as a term of abuse.*
 3 Astrid *Thank you.*
 ...
 4 Mark *Again, what was a nozem?*
 5 Astrid *Nozems were boys between 16 and 18 years old, mostly only lower educated and from lower social-economical background. They protested against abuses, but they were no criminals. Because they were bored they sometimes provoked, especially the police.*

The second fragment shows an example in which the meaning of a concept is not explicitly discussed. Eric and Lisa reason about changes in the 1960's and discuss the process of depillarization. They use the concept in order to describe the change in behavior of the youth. They relate the concept to the process of secularization (although this term is also not explicitly used).

Excerpt 2

An example of implicit use of historical concepts

- 1 Eric *It is about the youth who still go to church, but who start to ask themselves whether God exists.*
 2 Lisa *oh*
 3 Eric *The children of the fifties did not ask themselves these kinds of questions.*
 4 Lisa *Oh, then it is a clear change, I think.*
 5 Lisa *Yes, because in the fifties and the sixties there is also depillarization.*
 6 Eric *Yes, I have also read about that.*

Did the students reason collaboratively while reasoning about the past? Table 4.6 shows the amount of which students reasoned together or individually. It is shown that most historical reasoning reflected co-constructed reasoning for both the conditions. Individual reasoning also occurred regularly, reasoning dominated by one student not so often. The students in the evaluative condition showed more co-constructed reasoning, compared to the students in the explanatory condition. A t test for independent samples revealed that this difference is significant, $t(8) = 2.92, p \leq .05$). Therefore, the students who worked on the evaluative inquiry task showed significantly more co-constructed reasoning compared to the students who worked on the explanatory inquiry task.

Table 4.6

Mean frequencies and standard deviation of degree of co-construction in historical reasoning (N=10)

Degree of co-construction	Explanatory question		Evaluative question		<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Co-constructed reasoning	21.20	8.93	50.60	27.26	.05*
Dominated reasoning	4.80	5.63	11.00	7.87	.19
Individual reasoning	14.40	7.16	20.40	17.24	.49

* $p \leq .05$

Next, an example of a co-constructed historical reasoning is given. Paula and Wendy, who participated in the evaluation condition, discuss whether they think the 1960's were revolutionary or not.

Excerpt 3

An example of co-constructed historical reasoning

- 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 revolutionariness, 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.*

In this example Paula and Wendy discuss their point of view on the question whether the 1960's were revolutionary or not. In this reasoning historical concepts are used (e.g., depillarization). 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 build on the reasoning of the partner, as is shown in line 16 and 17.

4.6.2 The texts

The collaboratively written texts were scored on aspects of historical reasoning. The results for the two conditions are presented in Table 4.7. The texts showed all aspects of historical reasoning. The texts contained many (correct) descriptions of the time in which certain phenomena took place and of the changing behavior of the youth. The students of both groups did not score so high on giving explanations. Although some texts contained a reasonable number of explanations, the quality of these explanations was often low, and did not contain aspects such as the importance of the causes. When we look at differences between the two conditions we see that the texts that were produced in the evaluation condition showed a higher quality of historical reasoning compared to the texts that were produced in the explanatory condition. This difference is significant $t(8) = 2.63, p \leq .05$. As in the chat, the scores on the aspect viewpoint were significantly higher in the evaluative condition, $t(8) = 7.12, p \leq .001$). However, although the students in the explanatory condition talked more about explanations in the chat, they did not score significantly higher on this aspect in the text produced.

Table 4.7

Maximum scores, mean scores and standard deviations on aspects of historical reasoning in the text in two conditions and the results of t-tests for independent samples (N=10)

	Explanatory question			Evaluative question		<i>p</i>
	Maximum score	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Time	6	5.00	1.00	5.40	.89	.52
Change	8	5.40	.89	6.20	.84	.18
Explanation	8	4.20	1.64	3.40	.89	.37
Source	5	2.40	1.52	3.80	1.10	.13
Viewpoint	6	2.20	.84	5.40	.55	.00*
Concepts	9	6.20	.45	6.20	.84	1.00
<i>Total Score</i>	<i>42</i>	<i>25.40</i>	<i>3.58</i>	<i>30.40</i>	<i>2.30</i>	<i>.03*</i>

* $p \leq .05$

Of the six central concepts, the concept Provo was most often used in the text, followed by nozem and depillarization. Democratization, individualization, and second women liberation movement were hardly used and they were only used by a few of the 10 dyads. These results correspond with the way the concepts were used in the chat. The text also contained other historical concepts that were less central to the task, such as Second World War, industrialization, welfare, and rock and roll. On the average the dyads used 15 to 19 different historical concepts. They also used several methodological concepts, such as cause, consequence, fact, and change. On average they used 5 or 6 methodological

concepts. The historical concepts were most often used correctly, although some descriptions were somewhat vague or incomplete.

4.6.3 Individual learning outcomes

Did the students individually learn from this inquiry task? The results on the pretest and the posttest are presented in Table 4.8.

Table 4.8

Mean scores and standard deviations of the pretest and the post-test and results of a t-test for paired samples (N = 20)

Items	Pretest		Post-test		<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
1. Association task**	7.05	2.99	10.11	3.53	.00*
2. Time (phenomena)	6.55	1.50	6.75	1.80	.62
3. Time (photo)	5.65	2.06	6.30	1.75	.10
4. Change	2.85	.93	3.15	1.31	.25
5. Explanation	1.80	1.36	3.60	2.06	.00*
6. Source	1.95	1.14	2.90	1.12	.02*
7. Viewpoint	1.90	1.12	1.85	.99	.88
8. Concept definitions	6.05	2.24	7.10	2.34	.09
<i>Total score</i>	<i>34.40</i>	<i>7.40</i>	<i>41.55</i>	<i>9.25</i>	<i>.00*</i>

* $p \leq .05$

** $N = 19$

From Table 4.8 it can be concluded that the students did learn from the inquiry task. The total scores on the posttest improved significantly compared to the pretest. Analyses on the level of the different items showed that in the posttest the students' scores were significantly higher on the following items: association task, explanation, and the use of sources. The results on the association task showed that the students' ability to give correct associations on the 1950's and 1960's increased significantly. By correct associations we mean that the given association is correctly related to the 1950's and 1960's. For example, the first man on the moon is related to the 1960's and not the 1950's. Additional analysis was carried out on the association task. We investigated whether the associations were abstract or concrete. In the pretest the percentage abstract associations was 54.60 (on a total of 163 associations); in the posttest this percentage was 72.03 (on a total of 211 associations). Thus, the students were not only able to give more correct associations; the use of abstract associations also increased reasonably. Detailed analyses showed that the highest increase was related to the concepts nozem (pretest: 2 times mentioned; posttest: 10 times), Provo (3 and 12), and depillarization (1 and 16).

Although the students did not significantly improve on the total score of the concept definitions, additional analyses for each concept showed that students improved significantly on two concepts: nozem, $t(19) = 3.32$, $p < .01$ and Provo $t(19) = 2.13$, $p < .05$. The scores on the concepts democratization, depillarization, and second women liberation movement did not show a significant

difference, whereas the score on the concept individualization significantly decreased $t(19) = 2.35, p < .05$).

In Table 4.9 the scores on the posttest is compared for the two conditions. For the results on the posttest we expected that the students in the evaluation condition would show more overall learning gains. Besides, we expected that students in the explanatory condition would score better on the item explanation, and that the evaluation condition would score higher on the item viewpoint. Contrary to our expectations we did not find any differences between the two conditions on the results on the post-test, as is shown in Table 4.9.

Table 4.9

Mean scores and standard deviations of the post-test in two conditions and the results of t-tests for independent samples (N=20)

Items	<i>Explanatory question</i>		<i>Evaluative question</i>		<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
1. Association-task	9.44	4.22	10.70	2.87	.45
2. Time (phenomena)	6.60	1.90	9.90	1.79	.72
3. Time (photo)	6.40	1.71	6.20	1.87	.81
4. Change	3.20	1.40	3.10	1.29	.87
5. Explanation	4.10	2.47	3.10	1.52	.29
6. Source	2.50	1.35	3.30	0.67	.11
7. Viewpoint	1.70	1.06	2.00	0.94	.51
8. Concept definitions	7.00	2.31	7.20	2.49	.85
<i>Total score</i>	<i>40.60</i>	<i>10.15</i>	<i>42.50</i>	<i>8.70</i>	<i>.65</i>

* $p \leq .05$

4.7 Conclusions and discussion

In this chapter we presented the results of our study on historical reasoning in a CSCL environment. For this study, pairs of students were presented with an inquiry task, in which they had to study multiple historical sources in order to write a text. Two types of inquiry conditions were compared: a condition with an explanatory question and with an evaluative question. Analyses focused on the interaction process, more specifically on domain-specific reasoning and the co-construction of knowledge, the collaboratively written texts, and individual learning outcomes. First, we summarize our general findings on the analyses on student interaction in the chat and the learning outcomes. Then we discuss the differences between the two conditions. Finally, we describe the tools that can be made available in the CSCL environment and that may stimulate and support collaborative historical reasoning.

Analyses of the collaboratively written texts and the chat protocols showed that the inquiry task presented in this study elicited historical reasoning. All aspects of historical reasoning occurred in the text and in the chat. While reasoning historically, the students most of the time used historical

concepts in a correct way. The larger part of the historical reasoning episodes was co-constructed by both students. However, our analyses also showed some weak aspects of the student interaction in the chat. First, only 13% of all the utterances contained historical reasoning. Second, not all dyads showed all aspects of reasoning. For example, students hardly discussed the time in which phenomena took place. Although some dyads gave explanations for historical phenomena or gave a point of view, these were often of a poor quality or not well supported with arguments. Third, the meaning of historical concepts was hardly explicitly negotiated. This makes it difficult to evaluate whether the students really understood the concepts they used. Furthermore, more abstract concepts, such as democratization, individualization, and second women liberation movement were hardly used.

The results on the posttest indicated that the students did learn from the inquiry task. The students were, compared to the pretest, more able to give explanations, evaluate the trustworthiness of sources, and give definitions of the concepts *nozem* and *Provo*. Furthermore, the students improved significantly on the association task. They were not only able to give more correct associations, but also more abstract associations. Thus, after completing the inquiry task the students had a broader conceptual framework on the subject studied. Comparing the results of the chat, the text and the post-test, it can be concluded that the students used the concepts *nozem* and *Provo* often in the chat, in the text, in the associations task, and that they were able to give better definitions of these concepts. This finding is in line with the literature on concept learning, which suggests that students learn concepts by using them (Van Boxtel, 2000). However, more analyses on this data are needed to investigate the relation between the results on the interaction, the text and test.

The comparison between the two conditions showed that the type of inquiry question the students had to work on affected historical reasoning in the student interaction (chat) and in the jointly written text. First, the students who worked on the evaluative question showed more historical reasoning in the chat ($M_{\text{evaluation}} = 82$, $M_{\text{explanation}} = 40.2$, $t(8) = 2.15$; $p = .06$). Although the p value is not significant the .05 level, we do think this is worth mentioning, because the study was conducted with a small sample. They talked more about their point of view and about arguments to support that viewpoint, whereas students who had to explain a historical phenomenon talked more often about causes and explanations. In addition, the students in the evaluative condition more often contributed both to the historical reasoning and therefore showed more co-constructed reasoning. Furthermore, the students in the evaluative condition produced text of a significantly higher quality and the texts showed a more thorough historical reasoning. Furthermore, they scored higher on the aspect point of view, which was also more often discussed in the chat. However, although the students in the explanatory condition discussed more about explanations in the chat, they did not score higher on this aspect in the text. The students in the evaluative condition, who hardly discussed explanations, did mention explanations in the text. Therefore, this finding suggests that an explanatory question elicits historical reasoning about explanations in the chat and text, whereas the evaluative question elicits historical reasoning about a point of view in the text and chat, and the giving of explanations in the

text. Concerning the individual learning outcomes, we expected to find the same differences in scores on the items concerning explanation and point of view. Contrary to this expectation, we did not find that these differences had an impact on the individual learning outcomes. Although the mean scores of the items point in the direction we expected, the differences were not significant.

In interpreting the results we have to take into consideration that this study was as small-scale study in which only 10 dyads and students from one school were participating. Although the two groups were randomly assigned to one of the conditions and did not show difference in scores on the pretest, we have to handle the outcomes with care. A replication of this study in which more subjects participate would be necessary in order to generalize the conclusions to a broader setting. The differences between the two types of inquiry tasks found here do not indicate that an explanatory task is a less useful task. The results mainly indicate that the tasks elicit different kinds of historical reasoning. Using an explanatory inquiry question can be very useful if the goal of the teacher is to focus on the explanation of historical events, which is an important aspect of learning history.

From this study it can be concluded that a computer-supported inquiry task is a type of task that elicits historical reasoning and learning. In particular, an evaluative inquiry question seems to have the potential to elicit co-constructed historical reasoning in the chat and a higher quality of historical reasoning in the text. However, although students did reason about history, they did not always use all aspects of reasoning, nor did they use all the selected concepts so often. Also, the argumentation of students' point of view in the text were often of poor quality, as hardly any arguments were given to support this viewpoint, nor were counterarguments given or different arguments weighed. This finding is in line with the statement of Spoehr and Spoehr (1994) that the hardest part of historical thinking and reasoning is learning to anticipate counterarguments, to weigh alternate explanations for the phenomena being explained, and to be able to explain why one interpretation seems preferable to others. Therefore, students should be better supported to reason collaboratively about their point of view and discuss and weigh different arguments.

Adding extra tools to the CSCL environment might support collaborative historical reasoning. Research has shown that several tools can support the construction of knowledge, the communication between the students, and the co-construction of a group product, such as argumentative diagrams, matrices, and concept maps (Suthers, 2001; Veerman, 2000). Graphical representations such as an argumentative diagram can be especially meaningful because of their communicative and cognitive function (Erkens, Kanselaar, Jaspers, & Schijf, 2001; Suthers & Hundhausen, 2001). From a communicative perspective, it contributes to a shared understanding and a joint problem space between colearners, and enables them to focus on salient knowledge (Crook, 1998; Suthers & Hundhausen 2001; Veerman & Treasure-Jones, 1999). From a cognitive 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 favor of a position (Suthers & Hundhausen, 2002). In our next study we intend to compare different tools for supporting co-constructed historical reasoning. We will compare an argumentative diagram, which is a graphical representation, with an argument list (a linear representation) and a matrix (a different form of a graphical representation). In an experimental design these three tools will be compared to a control group. Each condition will consist of 30 students. We will use the evaluative inquiry question because it seems to have more potential to elicit historical reasoning. We expect that the use of the graphical tools will elicit more co-constructed historical reasoning.

4.8 Additional analysis: Elaboration

When writing this chapter, the analyses of the student interaction was not yet completely finished. Therefore, some results that have been analyzed later, were not reported in this chapter. Since these analyses are considered important for our research, we do like to mention them. The missing results concern the aspect of elaboration, which is together with type of historical reasoning and degree of co-construction one of the perspectives used to analyze historical reasoning episodes. We will next summarize these findings.

4.8.1 Elaboration and co-elaborated historical reasoning

The historical reasoning episodes were analyzed from the perspectives of (1) historical reasoning, (2) co-construction, and (3) elaboration. The elaboration perspective focuses on the types and quality of the cognitive process during group work. Elaborative activities are considered important ingredients of productive student interaction. Examples of elaborative activities are: the verbalization of prior knowledge, questioning, and the creation of meaningful relations by giving examples, using analogies, and reformulating or referring to previous experiences.

In our analyses, we discern three types of elaborative episodes: question-answer episodes, reasoning episodes, and conflict episodes (Van Boxtel, 2000). Episodes that do not contain a elaboration were coded as 'no-elaboration'. In addition, historical reasoning episodes that reflect both elaboration and co-construction were identified, since we expect that especially these interaction episodes contribute to learning. We refer to these episodes by the term *co-elaborated historical reasoning*. Interrater reliability of the variable elaboration was measured between two judges and over four randomly chosen chat protocols (124 historical reasoning episodes) and reached .94 (Cohen's κ).

In general the results show that the larger part of the historical reasoning episodes are elaborated, and about half of the historical reasoning episodes is co-elaborated (7.5% on the total

number of utterances, remind that historical reasoning was 13%). Table 4.10 shows the amount and type of elaboration in the historical reasoning episodes for both conditions. The results reveal that the evaluative question enhanced significantly more elaboration in the chat discussions, than the explanatory question. Moreover, the evaluative question elicits significantly more co-elaborated historical reasoning. In addition, the results show that elaboration is most often occurs in a reasoning episode or is elicited by a question, whereas conflicts hardly occur.

Table 4.10

Mean frequencies and standard deviation of the degree of co-construction in historical reasoning (N = 10)

	Explanatory question		Evaluative question		<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Elaboration	29.80	11.21	67.40	20.86	.01*
-Question	11.60	3.21	31.60	22.70	.09
-Conflict	3.20	5.07	9.80	17.78	.45
-Reasoning	15.00	14.35	26.00	17.22	.30
No elaboration	10.60	4.45	14.60	21.19	.69
<i>Co-elaborated historical reasoning</i>	<i>16.40</i>	<i>9.92</i>	<i>46.20</i>	<i>18.46</i>	<i>.01*</i>

* $p \leq .05$

In conclusion, the results suggest that the evaluative question seems to have more potential compared to the explanatory question to elicit elaborated historical reasoning. The evaluative question seems to elicit more historical reasoning, more co-construction, more elaboration, and thus also more co-elaborated historical reasoning.

CHAPTER 5 USING REPRESENTATIONAL TOOLS TO SUPPORT HISTORICAL REASONING IN COMPUTER-SUPPORTED COLLABORATIVE LEARNING²

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.

5.1 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.

² Van Drie, J., Van Boxtel, C., Erkens, G., & Kanselaar, G. (2005). Using representational tools to support historical reasoning in computer-supported collaborative learning. *Technology, Pedagogy and Education*, 14(1), 25-42.

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.

5.2 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.

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.

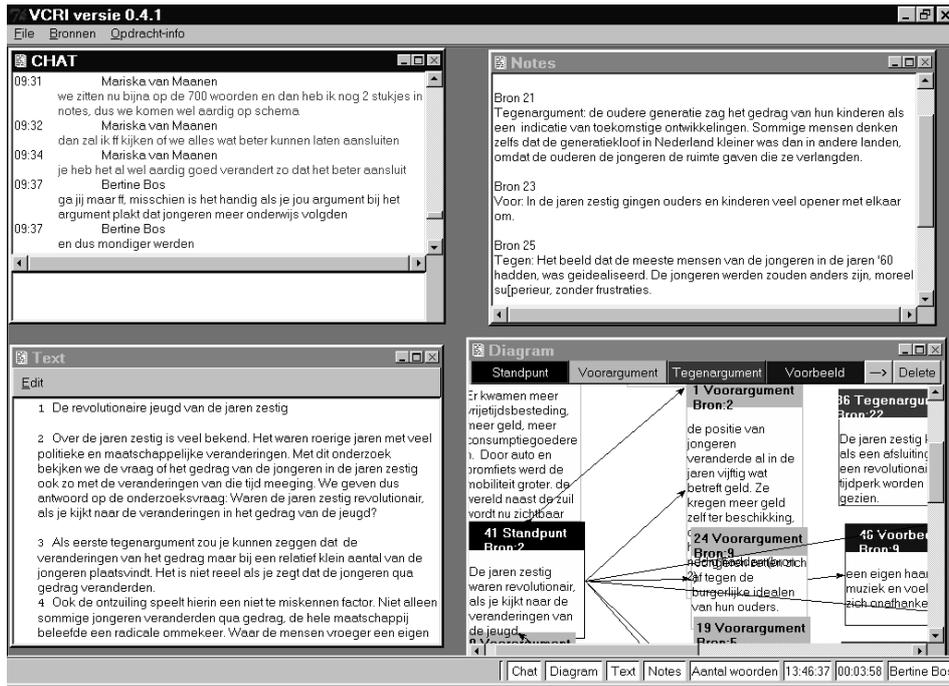
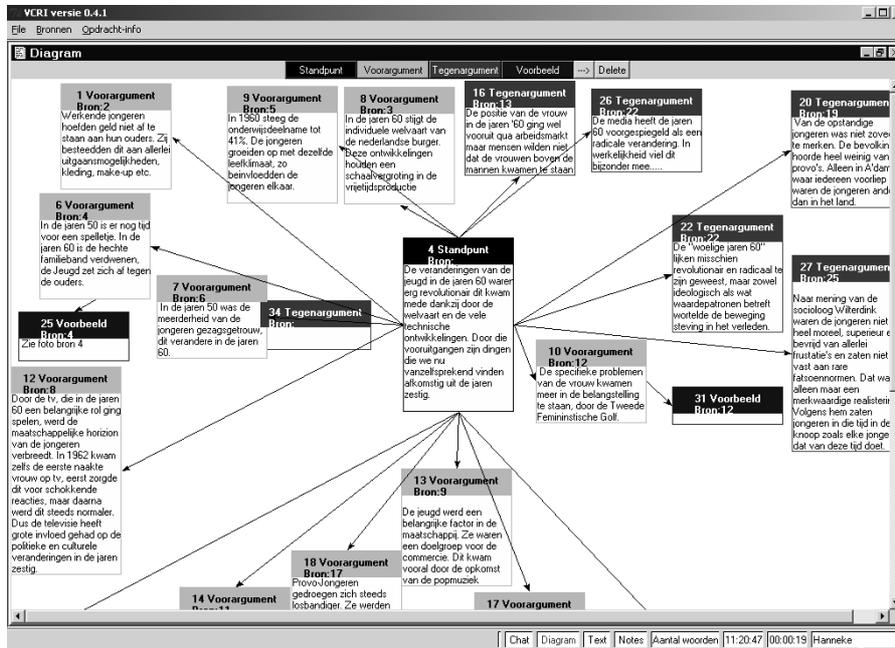


Figure 1. The main screen of VCRI for the diagram condition.



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).

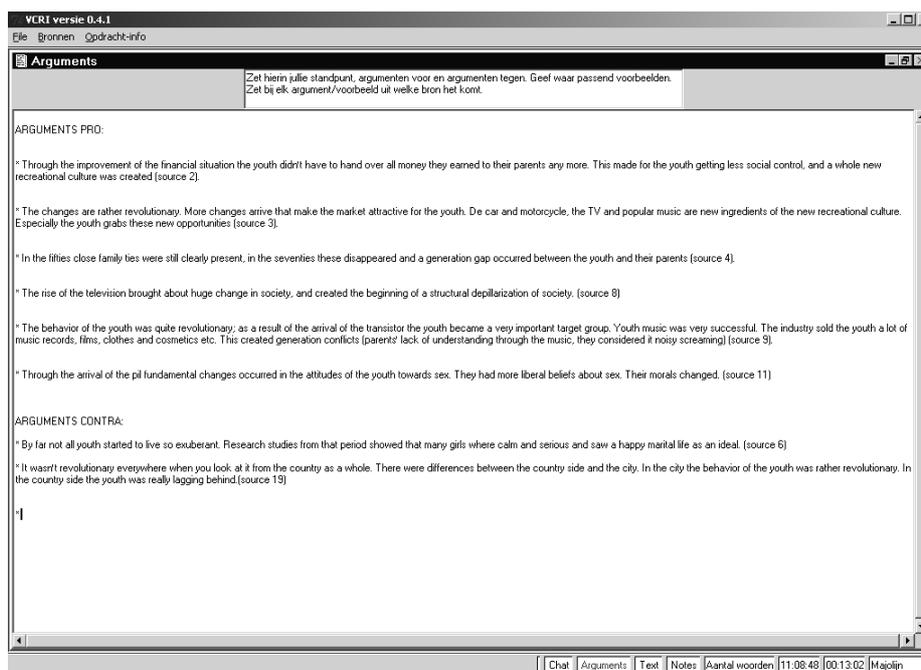


Figure 3. Example of a list constructed by one of the dyads (translated from Dutch).

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.

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.

Category	Description
<i>Task</i>	<i>Expressions concerning the content of the task</i>
-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
<i>Procedure</i>	<i>Expressions concerning the organization and planning of the task</i>
-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 organization
<i>Program</i>	<i>About technical aspects and program-related matters</i>
<i>Social</i>	<i>Concerning topics not related to the task or the program, but with a social function</i>
<i>Greetings</i>	<i>Greetings at the beginning or end of a working session</i>
<i>No code</i>	<i>Utterances that could not be coded as one of the previous categories</i>

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

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

* Depillarization refers to the breakdown of the strict division in socio-religious groups or pillars (Protestants, Catholics, Socialists, and Liberalists) that existed in Dutch society since 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 organizing 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).

5.3 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.

	Diagram (N=16)	List (N=14)	Total (N=30)	
Task acts	<i>M (Sd)</i>	<i>M (Sd)</i>	<i>M (Sd)</i>	%
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.

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. 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 ($M_{\text{diagram}} = 6.69, SD_{\text{diagram}} = 10.04; M_{\text{list}} = 9.64, SD_{\text{list}} = 10.26; t(28) = .80, p = .43$). 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 cont compared to the list condition ($t(28) = 3.1; p \leq .01$). We found no differences ributions are more equally distributed, in the equality of the contributions for the construction of the tool and the essay.

	Diagram(N=16)	List (N=14)		
	<i>M</i> (<i>Sd</i>)	<i>M</i> (<i>Sd</i>)	<i>t</i>	<i>p</i>
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)			
	<i>M</i> (<i>Sd</i>)		<i>M</i> (<i>Sd</i>)		<i>t</i>	<i>p</i>
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.

	Diagram (N=32)		List (N=28)			
	<i>M</i>	<i>Sd</i>	<i>M</i>	<i>Sd</i>	<i>t</i>	<i>p</i>
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.

Additional analyses showed that the list condition mentioned more arguments contra in their essays compared to the diagram condition ($M_{\text{diagram}} = 1.44$, $SD = 1.0$; $M_{\text{list}} = 2.2$, $SD = 0.7$; $t(28) = 2.49$; $p \leq .05$). 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 posttest.

5.4 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 pretest, 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.

CHAPTER 6 EFFECTS OF REPRESENTATIONAL GUIDANCE ON DOMAIN SPECIFIC REASONING³

Abstract

Computer-supported collaborative learning (CSCL) aims at enhancing and supporting peer interaction and the joint construction of products through technology. This study investigated the effects of the joint construction of external representations on the collaborative process and the learning outcomes. By providing representational guidance, the study aimed at promoting co-elaborated and domain-specific reasoning. Since it is assumed that the representational format may be of influence on the collaborative process and outcomes, three representational formats, namely an argumentative diagram, an argument list and a matrix, were compared with a control group. Sixty-five student pairs from pre-university education collaborated on a historical writing task in a CSCL environment. The analyses included analyses of interaction processes in the chat, the quality of the co-constructed representation, the quality of the essay and the scores on the individual posttest. The results indicated that each representational format has its own affordances and constraints. For example, Matrix users talked more about historical changes, whereas Diagram users were more focused on the balance in their argumentation. However, this did not result in differences in the quality of historical reasoning in the essay, nor in outcomes on the posttest.

Keywords: Computer-supported collaborative learning; External representations; Historical reasoning; Interaction analyses

6.1 Introduction

Current trends in the field of learning and instruction stress the importance of active knowledge construction and collaborative learning. Technology can play a major role in implementing these new trends in education (Kanselaar, De Jong, Andriessen, & Goodyear, 2000). Technology can support the construction of knowledge by representing learners' ideas and understandings and it can function as a social medium to support learning by dialogue. Computer-supported collaborative learning (CSCL) aims at enhancing and supporting peer interaction and the joint construction of products by the use of technology (Lipponen, 2002). The key factor that determines the success of CSCL can be found in the quality of the interaction processes students engage in. After all, meaningful learning in a collaborative environment is related to the quality of the interaction processes (Van der Linden, Erkens, Schmidt, &

³ Van Drie, J., Van Boxtel, C., Jaspers, J., & Kanselaar, G. (2005). Effects of representational guidance on domain specific reasoning in CSCL. *Computers in Human Behavior*, 21(4), 575-602.

Renshaw, 2000). Although research in the field of CSCL has resulted in positive learning outcomes (Lethinen, Hakkarainen, Lipponen, Rahikainen, & Muukonen, 2001), the use of CSCL is no guarantee for a productive dialogue (Kirschner, 2002; Stahl, 2002; Veldhuis-Diermanse, 2002). More research is needed to reveal under which conditions CSCL can lead to the intended knowledge construction. Important questions in this respect are: what *kind* of interaction processes promote collaborative knowledge construction and *how* can such interaction be provoked and supported?

Studies on collaborative learning processes are conducted from different perspectives. A distinction can be made between a domain-specific, an elaboration, and a co-construction perspective (Van Boxtel, 2004). The *domain-specific perspective* focuses on the propositional content and quality of the discourse. From this perspective an important question is whether the students make progress from their everyday reasoning towards a deeper understanding and more scientific ways of reasoning on the topic at hand. Types of talk that are of interest from a domain-specific perspective are the explication of one's own conceptions, the comparison of these conceptions with new information and interpretations of others, and the search for meaningful relations.

The *elaboration perspective* focuses on the types and quality of the cognitive processes during group work. Elaborative activities – such as the verbalization of prior knowledge, questioning, and the creation of meaningful relations by giving examples, using analogies, reformulating or referring to previous experiences – are considered important ingredients of a productive student interaction. From this perspective, it is important in a collaborative learning situation to promote elaborative talk. Elaborative talk is often constituted by the asking and answering of questions and through the elaboration of controversy by providing justification and argumentation.

The *co-construction perspective* puts the contingencies of the actions of both partners and the mediational role of tools in the centre. From this perspective, an important question is whether knowledge is really shared and co-constructed. In many groups participants do not equally contribute. Sometimes one of the participants does almost all of the talking and work, while the others passively watch and wait. Kumpulainen and Mutanen (1999) distinguished different modes of social processing. The *individualistic* mode implies that students work individually in the group and do not share ideas or try to co-construct meanings, the *dominative* mode reflects unequal participation, and the *collaborative* mode reflects joint meaning making. Co-construction of knowledge implies that meanings are extended, deepened or transformed because participants build on each other's contributions (Van Boxtel & Van Drie, 2003). Joint meaning-making and co-construction of knowledge requires a shared focus and coordination on the task content level, the meta-cognitive level and the socio-communicative level (Erkens, Kanselaar, Prangma, & Jaspers, 2003). In many studies one of the perspectives prevails, whereas a multi-perspective approach may have advantages in order to make progress in the design of collaborative learning environments. In the study reported here, a multi-perspective approach is adopted to investigate the role of representational tools for supporting historical reasoning in a computer-based collaborative inquiry and writing environment.

6.2 The potential of external representations

As has been stated before, using a CSCL environment does not automatically result in knowledge construction. This was confirmed in a previous study (Van Drie, Van Boxtel, & Van der Linden, in press), where a CSCL environment that enables students to collaboratively engage in a historical inquiry task and the collaborative writing of an essay was used. Students used a shared text processor, a private notepad, and had access to information sources. All communication between the collaborating students took place in an integrated chat facility. A writing task was used for several reasons. Previous research has shown that a writing task can deepen students' knowledge and understanding (Klein, 1999; Tynjälä et al., 2001) and may result in deeper historical understanding (Boscolo & Mason, 2001; Voss & Wiley, 1997). Moreover, collaborative writing can trigger critical reflection, externalization of thinking and immediate feedback (Gere & Stevens, 1989). Especially writing an argumentative text may result in a productive discussion, for learners may have different views or use different confronting arguments (Giroud, 1999; Veerman, 2000). Finally, small group inquiry task in which students jointly write an essay are more often used in current Dutch history education. The results of this study indicated that although students learned from the task and were engaged in historical reasoning in their chat discussions, the reasoning episodes were often very short and of poor quality. Furthermore, the collaboratively written essays did not show the quality that was expected.

Based on these results, different ways to promote and raise the level of historical reasoning both in chat and essay were considered. A possible way to support and improve collaborative learning in a computer-supported learning environment is by using representational tools. In the following sections, the potential of the collaborative construction of external representations in a historical writing task in CSCL is considered. The focus is on the way the construction of an external representation may support historical reasoning, elaboration, and co-construction in student interaction.

6.2.1 *Supporting historical reasoning*

From a domain-specific perspective it is important to know whether tools in a CSCL environment can promote thinking and reasoning within the domain at hand. In this study the focus is on the domain of history. Historical reasoning can be considered as a key aspect of building historical knowledge. Historical reasoning is always constructed in relation to a historical question or hypothesis. It implies that the learner situates historical phenomena in time, uses historical concepts, and organizes information to describe processes of change and continuity, to explain a historical phenomenon or to compare historical phenomena. Moreover, it implies supporting claims with arguments, making use of historical sources, and taking into consideration the trustworthiness, representativeness and usefulness

of the sources (Van Boxtel & Van Drie, 2004). Historical events, processes, and structures need to be organized to build an interpretative historical case (Leinhardt, Stainton, Virji, & Odoroff, 1994). This study investigated how the construction of an external representation influences the process of historical reasoning. The format used to display information is an important dimension of external representations (De Jong et al., 1998). Suthers and Hundhausen (2003) argue that the cognitive and social affordances of a representation depend on the representational notation. Different representational formats may support particular components of historical reasoning. For example, the construction of a causal diagram may provide guidance when learners are asked to explain a historical phenomenon, whereas a matrix can be a useful format to organize aspects of change and continuity. Furthermore, the representational artifact constructed in a representational tool can function as a writing aid. Experimental studies of Suthers et al. showed that representational notations can have significant effects on learners' discourse during the collaborative construction of external representations in the area of science. They compared the construction of three types of external representations: text document, matrix and diagram. In their study, students worked together behind one computer. The matrix group represented significantly more evidential relations; the empty cells in a matrix seemed to have prompted users to fill in all available evidential relations.

6.2.2 *Supporting elaboration*

From an elaboration perspective it is important that students are stimulated to engage in elaborate activities. Zhang and Norman (1994) state that external representations guide, constrain or determine cognitive behavior. Much research on the use of external representation focuses on the (individual) use of *presented* external representations. However, in a CSCL environment students are supposed to actively engage in the construction of their own knowledge, which implies that students themselves should (co-)construct representations. Cox (1999) claims that the self-construction of external representations may help to translate information from one type of representation to another, thus supporting deeper understanding of the underlying concepts and situations. Moreover, the *collaborative* construction of an external representation can promote verbalization of own conceptions, the (re-)ordering of information, and can provide perceptual assistance. A graphical representation, for example, can make information explicit and can direct attention to central problems and relations and help to distinguish core issues from more peripheral ones (Suthers & Hundhausen, 2001).

6.2.3 *Supporting co-construction*

An important condition for the co-construction of knowledge is that group members participate and contribute more or less equally and that they coordinate their activities. In face-to-face collaboration coordination is partly constituted by gesturing and using facial expressions (Schegloff, 1991), whereas the lack of these impose certain constraints on the coordination processes in electronic communication. In an electronic discourse via a chat facility it is important to coordinate and maintain

focus on the main issues (Veerman, 2000). From a co-construction perspective the question is whether external representations can contribute to the construction and maintenance of a shared understanding and a joint problem space between co-learners (Crook, 1998; Veerman & Treasure-Jones, 1999).

According to Suthers and Hundhausen (2003), an external representation can increase the conceptual complexity that can be handled in group interactions and facilitate elaboration on previously represented information. From this perspective, the representation can facilitate the co-construction of meanings through building on each other's contributions.

While reasoning within a domain, elaboration and co-construction are intertwined. Collaboration can stimulate the articulation of task-related knowledge and information. This verbalization makes it possible for ideas to be questioned, criticized and elaborated, and thus generates explanations, justifications and a search for new relations, which are important aspects of elaboration, historical reasoning and co-construction of knowledge.

6.3 Aim of the study

This study aims at supporting historical reasoning in a writing task in CSCL by providing representational guidance. The collaborative construction of external representations may support collaborative knowledge construction in a CSCL environment through the facilitation of (domain-specific) cognitive and communicative processes. Moreover, external representations may be helpful for organizing available information in the preparation of the co-authoring of an essay. The main question of this study is whether and how the co-construction of an external representation influences the collaborative process of knowledge construction and have an effect on the learning outcomes with respect to reasoning and learning in the domain of history. To examine the influence of the representational format, three different representational formats will be compared. The focus is especially on the appearance and quality of domain-specific reasoning, elaboration, and co-construction, for these processes are believed to constitute positive learning outcomes of collaborative learning.

6.4 Method

6.4.1 Design

The study consists of a pretest–posttest design with four conditions. In the experimental groups, students were asked to co-construct either an argumentative diagram with arguments pro and contra (Diagram condition), a list of arguments pro and contra (List condition)⁴ or a matrix in which changes

⁴ The datasets of the Diagram en List condition are the same as in the study described in Chapter 5.

can be described and characterized (Matrix condition). In the control condition, no representational tool was available and students did not receive instruction to co-construct an external representation. The experiment was conducted in two phases: in the first year the experiment was conducted for the Diagram and List condition, in the next year for the Matrix and Control condition.

6.4.2 *Participants*

Participants in this study were 157 students from six history classes in secondary (pre-university) education, aged 16–17. Three classes from two schools participated over a period of two years (same schools, teachers and level). The experiment took place at school, during the history lessons and lasted for six lessons in two weeks time. The students worked in pairs, each behind a computer and the pairs were divided over two computer labs. Pairs in which one of the students missed more than one lesson were excluded. The analyses included 130 students (65 pairs). Within their class, the students were randomly assigned to pairs and to one of the two conditions. In the first year of the experiment, 16 student pairs participated in the Diagram condition and 14 in the List condition. In the second year 18 student pairs participated in the Matrix condition and 17 in the Control condition. So, in each year the conditions were randomized over classes and schools.

6.4.3 *Task and learning environment*

Students performed a historical inquiry task that involved studying historical sources (such as 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 of whether the changes in the behavior of the Dutch youth in the nineteen sixties were revolutionary or not. Students worked for six lessons (of 50 min) on the task and did not receive instruction on the subject in advance. Students in the experimental conditions were instructed to collaboratively construct an external representation, for which they could use the historical sources. After finishing the construction of the representation, they could start co-writing the text, for which they could use the constructed representation and the sources. Students in the control group performed the same task, without the instruction to construct an external representation.

Students worked in a CSCL environment called Virtual Collaborative Research Institute (see <http://edugate.fss.uu.nl/vcri>; Jaspers & Erkens, 2002). VCRI is a groupware program that enables students to work collaboratively on an inquiry task and essay writing. Each student works at one computer, physically separated from the partner. Communication takes place by means of chat. Figure 6.1 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). The representational tools in the

experimental conditions are all shared tools. In the control group, no such shared tool was available. Below the representational tools that were used in the experimental conditions will be described.

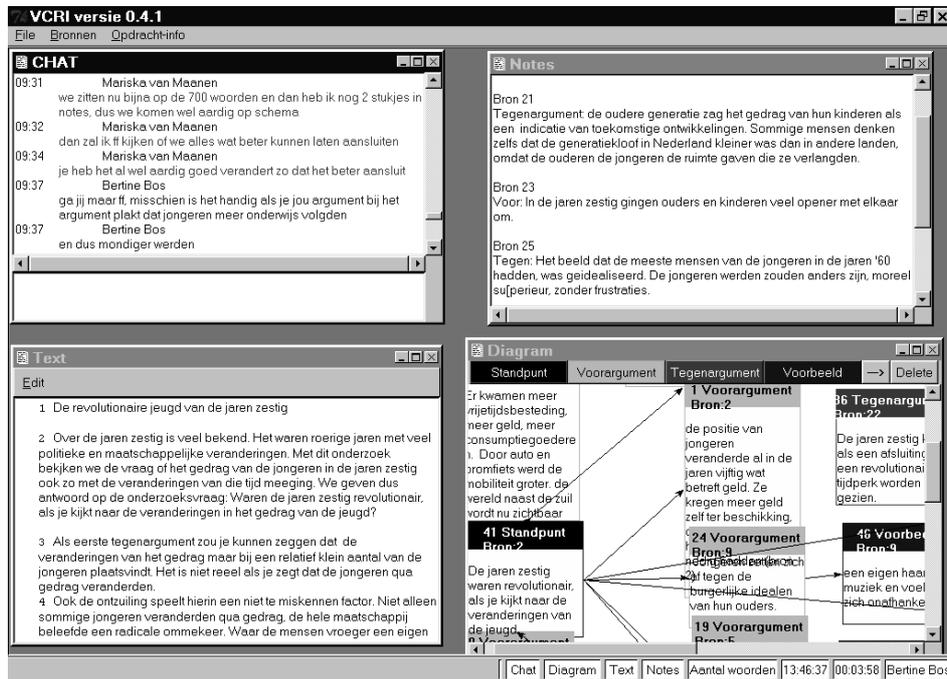
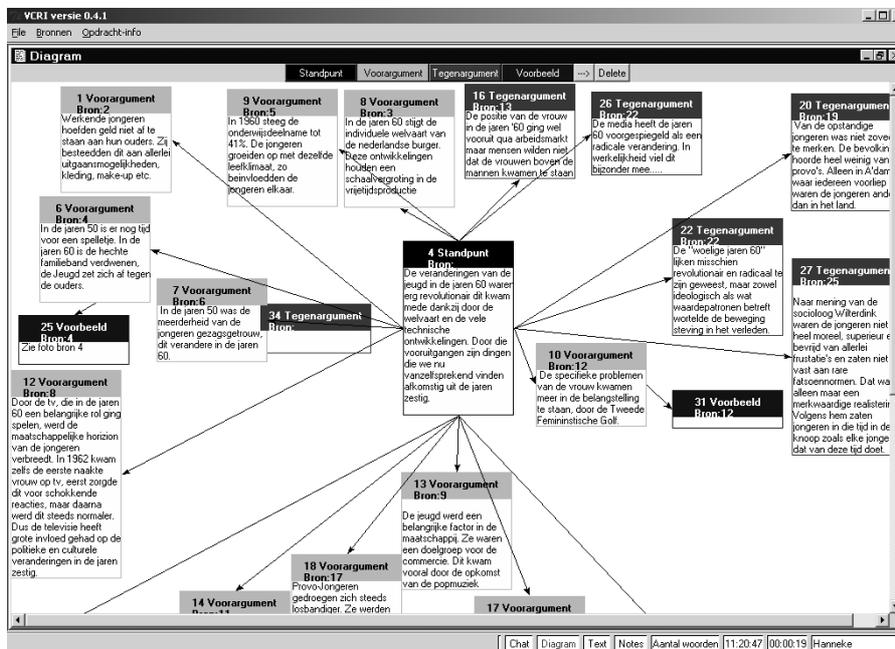


Figure 6.1. The main screen of VCRI for the diagram condition.



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

Figure 6.2. Example of a diagram constructed by one of the dyads (in Dutch).

6.4.3.1 Argumentative diagram

The task requires students to take a point of view on a historical issue and support it with arguments. In an argumentative diagram, a point of view and arguments pro and contra can be graphically represented. Figure 6.2 shows the diagram tool that was used in the study. Standpoint, arguments pro, arguments contra and examples can be represented in text-boxes, each with their own color. All text-boxes can be linked to each other by arrows. Furthermore, students can refer to the source from which the argument or the example derives in each box.

6.4.3.2 List

Whereas an argumentative diagram organizes and links arguments in a two-dimensional graphical way, the list organizes arguments in a linear way. In the List condition a list tool as is shown in Figure 6.3 was used. In this window, students can put together arguments pro and arguments contra.

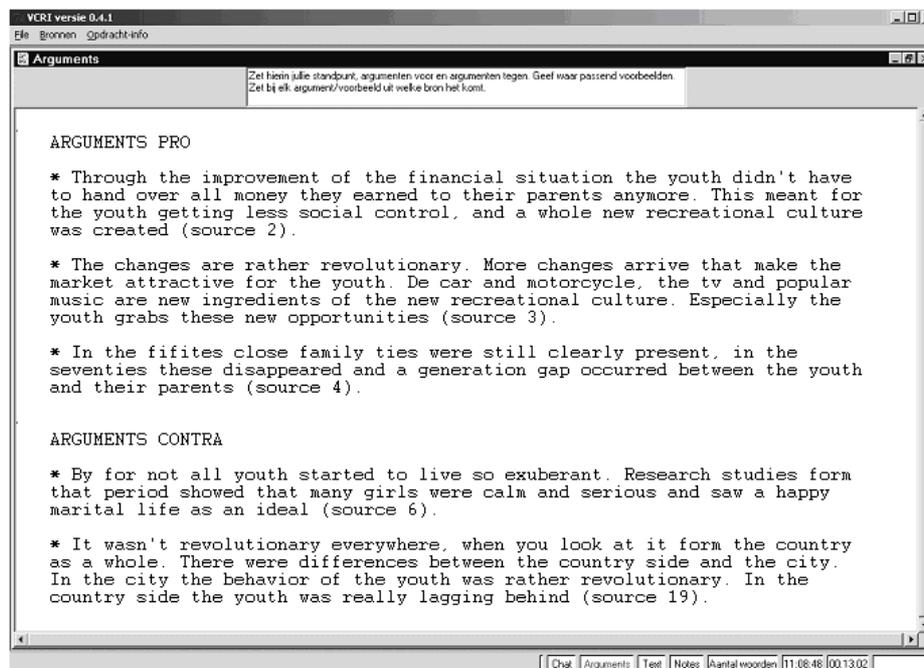


Figure 6.3. Example of a list constructed by one of the dyads (translated from Dutch).

6.4.3.3 Matrix

The argumentative diagram and list focus on the process of argumentation, and do not pay explicit attention to more domain-specific aspects of the argumentation process required by the task. The task is about historical change. Historical change can occur in very different areas, for instance beliefs, economic situation or family life. In describing and evaluating processes of change, historians often distinguish between political, economic, social, and cultural changes. Furthermore, they characterize changes according to their tempo and impact. A matrix is a format in which historical changes can be characterized using several columns. Figure 6.4 shows the matrix tool used in the study. The matrix

consists of a table format that can be filled in by the students. In the second column the number of the source can be added, in the third column students can describe the historical changes (or aspects of continuity) and in the fourth whether they think the change can be defined as revolutionary or not (yes or no). The last column contains a “sort” function. Students can categorize the changes in the way they choose. When they push on the sort button, all the changes are sorted. For example, the students who made the matrix in Figure 6.4 categorized the changes as cultural, political and economic. After sorting, all changes with the same label are listed.

id	Source	Description Changes	Revolutionary change?	Sort
5	00	Old ways of living, traditions and cultures were partly lost, secularization and decline of the youth movement	YES	Culture
6	00	Interference by the government decreased during the 1950s but did not disappear	NO	Politics
7	00	strong demand for fundamental changes during the 1960s	YES	Politics
9	02	Youngsters earned more money, so they did not need to give up their complete earnings to their parents	YES	Economy
8	03	New types of leisure activities due to increasing wealth	No	Economy
10	04	Parents had more time to spend time with their families	NO	Culture
11	05	Because the number of people pursuing an education increased rapidly, social differences between people diminished.	YES	Education
13	07	Nozems were not accepted by society. They were considered hopeless cases.	NO	Politics
12	08	The influence of television grew strongly during the 1960s, a structural depillarization took place, although depillarization was still visible in broadcasting	YES	Culture
17	09	The rise of new music was widely noticeable. Young people in particular were attracted by it.	Yes	Culture
14	10	Youth culture changed significantly between the 1950s and the 1960s; as became visible through the rise of popular idols, and a tendency to revolt against grownups.	YES	Culture

Figure 6.4. Example of a matrix constructed by one of the dyads (translated from Dutch).

6.4.4 Instruments and analyses

The analyses focused on the process of collaboration as well as on the products as outcomes of the collaboration. All actions taken during working on the task were logged. The analyses included the interaction processes in the chat protocols, the jointly constructed representations, the collaboratively written essays, and the results of the individual pretest and posttest. The analyses of the processes focused on historical reasoning, elaboration, and co-construction. Below the different analyses will be described in more detail.

6.4.4.1 Chat protocols

The interaction processes in the chat protocols were coded by using MEPA, a computer program for Multiple Episode Protocol Analysis (Erkens, 2002; see <http://edugate.fss.uu.nl/mepa>). The interaction processes in the chat were coded on the level of utterances and were first analyzed on the dimension of Task Acts. Five main categories were distinguished: utterances related to the content of the task at hand (Task), to procedures to perform the task (Procedures), 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 Procedures were divided in subcategories. Task utterances in which students say something about the past, give an interpretation of the past, or of the merit of sources, were coded as Historical reasoning.

Table 6.1

Coding definitions of historical reasoning episodes

Category	Description
Type	Content of the historical reasoning episode is related to:
time	historical time
description	describing the past
change	describing changes
explanation	giving explanations
source	interpretation and evaluation of sources
standpoint	providing a point of view and arguments
Elaboration	Extended historical reasoning episode, which starts with a:
question	question
conflict	negation, counter-argument or critical question
reasoning	statement
No elaboration	Historical reasoning episode that does not contain extended reasoning
Degree of co-construction	Degree to which the episode is co-constructed:
co-constructed	both students contribute equally to the reasoning
dominated	one student dominates the reasoning
individual	only one student contributes to the reasoning
<i>Co-elaborated historical reasoning</i>	<i>Extended historical reasoning episode to which both students equally contribute</i>

Utterances coded as Historical reasoning were further analyzed on a episodic level. An episode is defined as several subsequent historical reasoning utterances which belong to the same type of historical reasoning. These analyses are related to the three perspectives described above: domain-specific, elaboration and co-construction, and can be found in Table 6.1. With regard to the domain-specific perspective, six types of historical reasoning episodes were distinguished, namely episodes in which (1) historical phenomena are situated in time, (2) the past is described, (3) changes (or continuity) are described, (4) the past is explained, (5) the sources are discussed, and (6) a point of view is taken and supported with arguments. The historical reasoning episodes were next analyzed on the appearance and type of elaboration. Three types of elaboration were distinguished: question,

conflict and reasoning (Van Boxtel, 2000). Episodes that did not contain an elaboration, were coded as No Elaboration. Furthermore, the degree of co-construction in the historical reasoning episodes was analyzed. Inspired by the modes of social processing of Kumpulainen and Mutanen (1999) the following distinction was made: individual reasoning, reasoning dominated by one of the students, and co-construction.

Historical reasoning episodes were coded as *co-elaborated historical reasoning* whenever the reasoning reflected both elaboration and co-construction. Table 6.2 shows an example of co-elaborated historical reasoning (Van Drie et al., in press). 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.

Table 6.2

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

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

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

For all categories mentioned in this section (with the exception of asymmetry for that was calculated on the basis of information that was logged by the computer) the inter-rater reliability was measured by two coders (the first and second author) over four randomly chosen chat protocols from a pilot study. The agreement varied between 83% and 98%, and Cohen's κ varied between 0.69 and 0.95.

6.4.4.2 External representations

The external representations the students produced in the experimental conditions were scored on the number of arguments pro and contra. The inter-rater reliability (Cohen's κ) over 12 randomly chosen representations was 0.89 for the arguments pro and 0.78 for the arguments contra. 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 were also included in the analyses. The balance refers to the difference between the number of arguments pro and the arguments contra. A higher score on this measure means less balance. It should be noted that based upon the sources that were provided, more arguments pro could be identified compared to arguments contra. In sum, sixteen arguments pro could be identified from the sources and ten arguments contra.

6.4.4.3 Essays

Essays were scored on six aspects of historical reasoning: time references, changes and continuity, explanations, use of sources, argumentation, and the use of historical concepts. The scoring took into account both amount and quality. For example, the number of explanations given, and the quality of the explanations given. Furthermore, a score was given for the structure of the complete essay. The maximum score on the essay was 60 points. The inter-rater reliability between two coders on ten essays, turned out to be 0.59 (Cohen's κ ; agreement 72%). This outcome is considered sufficient, since assessing texts is highly interpretative. However, it was decided to score all essays independently by two coders, compare the results, and discuss differences until agreement was reached.

6.4.4.4 Pretest and posttest

The pretest and posttest focused on subject knowledge about the sixties, since the aim of the task was to improve subject-matter knowledge. The test contained seven open answer questions and one multiple-choice question. The items were constructed in line with the different aspects of historical reasoning (see Table 6.3). The pretest and the posttest consisted of the same questions, only for some items different historical sources (for example a different picture or text) were used. The maximum score on both tests was 79. The inter-rater reliability of the scoring, on ten randomly chosen tests, varied between 0.70 and 1.00 (Cohen's κ). After excluding item 1a, in which the students had to give associations on the fifties, the item homogeneity (Cronbach's α) turned out to be acceptable (pretest 0.72; posttest 0.64).

Table 6.3

Description of the items of the pre- and posttest and maximum scores

Item	Description	Components of historical reasoning	Max score
1a	Associations fifties ^a	–	7
1b	Associations sixties ^a		7
2	Situating historical phenomena in time ^b	Time	10
3	Giving a definition of four concepts	Concepts	8
4	Giving examples of four concepts	Concepts	8
5a	Giving characteristics of the youth in the fifties	Change	4
5b	Describing changes in the behavior of the youth in the sixties	Change	4
6a	Giving causes for the changes in the behavior of the youth in the sixties	Explanation	10
6b	Indicating the most important cause	Explanation	2
7a	Giving arguments pro the given statement	Standpoint	6
7b	Giving arguments contra the given statement	Standpoint	6
8a	Interpretation of a source	Source	2
8b	Interpretation of a source	Source	2
8c	Evaluating the trustworthiness of both sources	Source	3

^a Association item: item in which students are asked to give associations on the fifties and the sixties in a mind map.

^b Multiple-choice items. The answers were correct or false.

6.4.4.5 Questionnaire

After finishing the assignment the students were asked to fill out a questionnaire that contained evaluative questions about the task and the computer environment.

6.4.5 Hypotheses

In this study the influence of the co-construction of an external representation in a writing task in CSCL is investigated. Three different representational format (a diagram, list and matrix) are compared to a control group, which included the same task without the collaborative construction of an external representation. It is expected that compared to the control group, the experimental conditions (Diagram, List and Matrix) would show more co-elaborated historical reasoning in the chat, would produce better essays and would have higher scores on the posttest. In order to verify the assumption that the amount of co-elaborated historical reasoning, the quality of the constructed representation, the quality of the essay and the scores on the posttest are positively related, the correlations between these variables will be calculated.

Based upon the characteristics of the different representational formats used, differences between the three experimental conditions in historical reasoning, the constructed representations and the written essays are expected. Historical change and argumentation are important elements of the task used in this study. It is hypothesized that the chat protocols in the Matrix condition, compared to the Diagram and the List, would show more talk about historical changes, for the columns in the matrix direct attention to describing historical changes and deciding whether each of these changes can be considered revolutionary or not. In addition, for the Matrix condition higher scores on the aspect of

historical change in the essay and on the posttest are expected. The List and Diagram both focus on the process of argumentation and it is therefore expected that students in these conditions would show more discussion about their standpoint in the chat, and have higher scores for argumentation in the essay and on the posttest. Moreover, it is expected that the graphical format of the diagram would have more potential to promote balance in the representation of arguments pro and contra than a linear format. The balance between arguments pro and contra is more salient in a diagram, since one can easily see whether it is even or uneven.

6.5 Results

In this section, the results of the analyses of the interaction processes, the collaboratively constructed products and the individual learning outcomes are presented, as well as the outcomes of correlational analyses. To test differences between the conditions, both univariate and multivariate analyses of variance were carried out. First, the conditions were compared on students' subject knowledge about the nineteen sixties, measured by the pretest. A one-way ANOVA revealed that the scores were significantly different for the four conditions on the individual level ($F(3, 126) = 16.17; p \leq 0.00$). Also at the level of pairs (for which the average score of both students was taken) a one-way ANOVA yielded a significant difference between the conditions ($F(3, 61) = 14.03; p \leq 0.00$). Post hoc tests (Dunnett's C) indicated that the student-pairs in both the Diagram ($M = 27.8; SD = 2.7$) and List condition ($M = 27.9; SD = 4.6$) scored significantly higher on the pretest ($p \leq 0.05$), than the student-pairs in the Matrix ($M = 21.8; SD = 5.2$) and Control condition ($M = 18.7; SD = 6.1$). Therefore, the average pretest-score of the dyads was used as a covariate in the univariate and multivariate analyses. To indicate differences between the conditions simple contrast analyses were carried out. Differences are considered significant when $p \leq 0.05$. When different analyses were conducted, this will be explicitly mentioned.

6.5.1 Co-elaborated historical reasoning in the chat protocols

The mean length of protocols was 361.4 utterances ($SD = 171.5$). ANCOVA revealed that the length of the protocols (see Table 6.4) was significantly different for the conditions ($F(3, 60) = 4.47; p \leq 0.01$). Simple contrast analyses indicated that the Control condition produced more chat-utterances than Diagram and List, and that the Matrix produced more utterances than the Diagram. Thus, although all students had worked for 6 h on the task, the students in the Control and Matrix condition produced more utterances in the chat.

All utterances in the chat protocols were first coded on the level of Task Acts and are presented in Table 6.4. In general, the analyses of the Task Acts showed that most of the Task Acts were directly related to the assignment: 46% of the utterances were related to Procedures and 33% to

Task. About 21% of the utterances was about the technical functioning of the program (Program), social talk (Social) and Greetings at the beginning or the end of a session. Furthermore, it worth noting that a relatively high percentage of utterances was coded Coordination (26%).

Table 6.4

Mean frequencies and standard deviations of task acts in chat protocols (N = 65)

Task acts	Diagram (N = 16)		List (N = 14)		Matrix (N = 18)		Control (N = 17)	
	M	SD	M	SD	M	SD	M	SD
Task*	77.3	(30.6)	102.1	(52.5)	128.2	(60.7)	153.2	(72.6)
Historical reasoning*	16.4-	(14.3)	17.6-	(11.0)	34.3+	(23.4)	35.2+	(35.3)
Representation	19.8+	(14.2)	8.6-	(6.7)	13.9	(10.5)	- ^a	
Text construction*	11.5-o	(6.9)	22.0-	(13.1)	22.6-x	(14.4)	39.2+	(22.3)
Revision*	4.3-o	(3.8)	12.1-	(15.6)	9.1-x	(12.1)	17.7+	(16.9)
Goal	8.2	(5.7)	13.4	(14.2)	17.3	(13.0)	13.9	(10.9)
Resources	3.0	(3.8)	7.1	(9.1)	7.6	(8.8)	6.5	(7.2)
Evaluation task*	8.5-	(4.8)	10.1-	(8.3)	14.8-	(11.1)	22.8+	(13.0)
Word count*	5.4-	(3.6)	10.1-	(9.1)	11.4-	(8.5)	18.4+	(13.9)
Procedures*	121.4	(60.6)	132.4	(80.0)	187.3	(65.7)	192.2	(81.7)
Coordination	75.6	(44.9)	90.5	(53.0)	91.6	(34.9)	106.0	(58.4)
Task approach*	18.6-	(10.6)	20.7-	(8.6)	51.4+	(30.4)	53.1+	(25.2)
Planning	7.3	(4.6)	7.6	(7.3)	13.3	(9.0)	15.3	(14.7)
Turn taking*	17.7-	(15.5)	16.1-	(13.8)	28.5+	(15.8)	15.0-	(12.6)
Evaluation	2.3	(2.7)	2.6	(3.9)	2.5	(3.6)	2.9	(3.8)
Program	17.6	(15.3)	28.0	(28.6)	13.3	(13.1)	12.4	(13.8)
Social	35.9	(43.0)	29.3	(25.2)	35.1	(56.4)	41.1	(43.3)
Greeting	19.5	(8.5)	23.1	(8.8)	19.1	(7.8)	27.5	(8.0)
No Code	0.4	(1.8)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
<i>Total</i>	<i>271.9</i>	<i>(108.5)</i>	<i>320.7</i>	<i>(170.2)</i>	<i>384.0</i>	<i>(137.9)</i>	<i>426.5</i>	<i>(180.1)</i>

Note. Means are unadjusted means.

Post hoc analysis: + sign. > -; x sign. > o.

^a In the control group no representational tool was used.

* $p \leq 0.05$.

A MANCOVA, with the average pretest scores of the pairs as covariate, was used to test whether there were differences between the conditions for the subcategories of the variable Task and the variable Procedures. First, a MANCOVA for the variable Task was conducted. The subcategory Representation was left out, since the Control condition had no representation and therefore no Task Acts related to Representation. An overall effect was found ($F(21, 158) = 2.68; p \leq 0.00$), with significant differences for the subcategories: Historical Reasoning ($p \leq 0.01$), Text Construction ($p \leq 0.00$), Revision ($p \leq 0.00$), Task Evaluation ($p \leq 0.01$), and Word Count ($p \leq 0.05$). It was expected that the Experimental conditions would show more historical reasoning compared to the Control condition, however, the results indicated differently. Both the Control and Matrix condition scored higher compared to Diagram and List on Historical Reasoning. In addition, the Control condition scored significantly higher compared to the other tree conditions on Text Construction, Revision, Task Evaluation, and Word Count. The Matrix condition scored higher than the Diagram on Text

Construction and Revision. In other words, the Control condition scored higher on those variables that were directly related to the process of text-writing. An ANCOVA was carried out on the subcategory Representation, which yielded a significant difference between the three experimental conditions ($F(2, 44) = 3.97; p \leq 0.05$). Significantly more utterances were related to Representation in the Diagram, compared to the List condition.

Next, a MANCOVA was conducted on the subcategories of the variable Procedures. An overall effect was found ($F(15, 164) = 2.30, p \leq 0.01$), with significant differences for the subcategories: Approach ($p \leq 0.01$), and Turn Taking ($p \leq 0.05$). Both in the Control and Matrix condition the students talked significantly more about the approach of the task, compared to the students in the List and Diagram condition. In the Matrix condition significantly more utterances were related to Turn Taking compared to the other three conditions.

As shown above, both the Control and Matrix condition scored higher compared to Diagram and List on the amount of historical reasoning. Historical reasoning episodes were also analyzed on the type of historical reasoning, the amount of elaboration and the degree of co-construction. The results of these analyses are shown in Table 6.5 and Table 6.6. Notice, that instead of the number of episodes, the number of utterances that are part of the different types of historical reasoning episodes are mentioned in this table. In this way, the length of the episodes can be taken into account.

Table 6.5

Mean frequencies and standard deviations of historical reasoning in chat protocols and the results of analyses of variance (N = 65)

Historical reasoning	Diagram (N = 16)	List (N = 14)	Matrix (N = 18)	Control (N = 17)	F	p
Time	0.4- (1.1)	1.3- (2.8)	1.2- (3.0)	5.1+ (6.5)	3.77	0.02*
Description	3.4- (4.9)	2.3-o (3.2)	5.2x (5.9)	6.8+ (11.1)	2.87	0.04*
Change	3.4- (5.0)	2.9- (4.2)	14.1+ (15.4)	6.1 (11.8)	4.57	0.01**
Explanation	0.4 (1.3)	0.9 (2.7)	1.2 (3.5)	0.8 (2.9)	0.37	0.78
Source	0.7 (1.8)	0.1 (0.5)	1.4 (5.2)	0.9 (3.0)	0.55	0.65
Standpoint	8.4 (6.6)	10.1 (7.1)	11.2 (11.5)	15.5 (17.1)	2.61	0.06

Note. Means are unadjusted means. Post hoc analysis: + sign. > -; x sign. > o.

* $p \leq 0.05$.

** $p \leq 0.01$.

With respect to the different components of historical reasoning, the results indicated that most historical reasoning was about historical changes in the sixties and the point of view students take (see Table 6.5). Both of these aspects were central to the task at hand. It was expected that the Matrix condition would show more talk about historical changes, and that the Diagram condition would show more utterances reflecting students' point of view regarding the historical issue at hand. A MANCOVA on the components of historical reasoning revealed an overall effect ($F(18, 161) = 2.06; p \leq 0.01$). Significant differences between the conditions were found for the categories Time ($p \leq 0.05$), Description ($p \leq 0.05$), and Change ($p \leq 0.01$). Simple contrast analyses revealed that students in the Matrix condition talked significantly more about historical changes compared to students in the

Diagram and List condition, which is in line with the expectations. Furthermore, students in the Control condition made more time-references compared to the students in the other three conditions. Both the Control and Matrix condition scored significantly higher on Description compared to the List condition, and the Control condition also scored higher compared to the Diagram for this category.

The mean frequencies of utterances that were part of an elaborated historical reasoning episode are given in Table 6.6. Most elaboration was related to the asking and answering of questions. An ANCOVA revealed a significant difference between the conditions for the total amount of elaboration ($p \leq 0.01$). Both the Matrix and Control condition scored significantly higher on Elaboration compared to the Diagram and List condition. With regard to the type of elaboration the analyses showed a significant difference for Question ($p \leq 0.01$) and Reasoning ($p \leq 0.05$). Both the Control and Matrix condition scored higher on Question compared to the Diagram and List condition. The Control condition scored also higher on Reasoning compared to the Diagram and List.

Table 6.6

Mean frequencies and standard deviations of elaboration, co-construction and co-elaboration in historical reasoning episodes in chat protocols and the results of analyses of variance (N = 65)

	Diagram (N = 16)	List (N = 14)	Matrix (N = 18)	Control (N = 17)	F	p
Elaboration	12.2- (12.7)	11.8- (10.4)	20.9+ (18.2)	27.1+ (32.4)	5.31	0.00**
– Question	6.1- (9.1)	7.2- (8.4)	10.5+ (9.0)	13.2+ (12.2)	4.15	0.01**
– Conflict	0.9 (3.0)	1.4 (4.0)	2.0 (6.1)	0.9 (2.7)	0.80	0.50
– Reasoning	5.1- (5.3)	3.1- (4.3)	8.4 (11.7)	13.0+ (21.7)	3.31	0.03*
No elaboration	4.6 (4.8)	5.9 (6.1)	13.4 (16.8)	8.1 (5.5)	2.04	0.12
Degree of co-construction						
– Co-construction	7.6- (10.5)	10.3- (9.8)	22.8+ (20.0)	28.4+ (31.1)	5.36	0.00**
– Domination	3.4 (5.1)	2.2 (4.1)	4.2 (7.1)	3.3 (4.2)	0.83	0.48
– Individual	5.8 (4.9)	5.0 (5.9)	7.3 (7.4)	3.5 (4.1)	1.39	0.26
<i>Co-elaboration</i>	<i>6.7-o (10.0)</i>	<i>9.6- (10.3)</i>	<i>13.4-x (13.7)</i>	<i>23.9 (30.4)+</i>	<i>5.47</i>	<i>0.00**</i>

Note. Means are unadjusted means. Post hoc analysis: + sign. > -; x sign. > o.

* $p \leq 0.05$.

** $p \leq 0.01$.

Table 6.6 also presents the results for the degree of co-construction in historical reasoning. An ANCOVA revealed a significant effect Co-construction ($p \leq 0.01$). Simple contrast analysis indicated that both the Control and Matrix condition scored higher on Co-construction compared to the Diagram and List condition. In addition, it was expected that the conditions with a representational tool would show more co-elaborated historical reasoning than the Control condition. However, the results indicated the contrary. Analysis of variance showed a significant difference between the conditions for the amount of co-elaborated historical reasoning ($p \leq 0.01$; see Table 6.6). The Control condition showed significantly more co-elaborated historical reasoning compared to the Diagram, List and the

Matrix. Moreover, the Matrix showed more co-elaborated historical reasoning compared to the Diagram.

6.5.2 Constructed representations

In the experimental conditions, the students collaboratively constructed a representation. The question now arises as to whether the three representational formats resulted in differences in the number of represented arguments, the balance between arguments pro and contra, the number of sources used and the equality of participation in the construction of the representation. The results of an ANCOVA, presented in Table 6.7, confirm an effect of the conditions on the total number of arguments ($p \leq 0.01$), the number of arguments pro ($p \leq 0.01$) and arguments contra ($p \leq 0.01$). Simple contrast analyses revealed that in both the List and in the Matrix condition more arguments were used compared to the Diagram condition. The Matrix scored significantly higher on Arguments Pro compared to both the List and Diagram, whereas the List scored higher than the Diagram. With regard to Arguments Contra both List and Matrix scored higher compared to Diagram.

Table 6.7

Mean scores and standard deviations of the representation for the experimental conditions and results of analysis of variance (N = 48)

	Diagram (N = 16)	List (N = 14)	Matrix (N = 18)	F	p
Total arguments	13.5 – (3.7)	17.6+ (3.1)	18.6+ (2.0)	13.60	0.00**
– Arguments pro	8.9–o (2.4)	10.9–x (1.6)	12.5+ (1.2)	17.10	0.00**
– Arguments contra	4.6– (1.9)	6.7+ (2.5)	6.1+ (1.7)	4.64	0.01**
Balance pro and contra	4.3– (2.3)	4.2– (2.8)	6.4+ (2.1)	4.78	0.01**
Sources used	14.3–o (4.8)	20.9–x (4.5)	25.1+ (0.7)	36.89	0.00**

Note. Means are unadjusted means. Post hoc analysis: + sign. > –; x sign. > o.

* $p \leq 0.05$.

** $p \leq 0.01$.

Additionally, the balance between the arguments pro and contra was analyzed (see Table 6.7). The balance was computed as the difference between the number of arguments pro and the number of arguments contra. A larger score means less balance. An ANCOVA revealed a significant difference between the conditions. Simple contrast analyses indicated that the Matrix showed less balance compared to the Diagram and List. Table 6.7 also shows the number of sources used in the representations. In sum, 26 sources were available. In the Matrix condition almost all sources were used and in the Diagram condition students used the least number of sources. An ANCOVA revealed a significant difference between the conditions (see Table 6.7) and simple contrast analyses showed that this difference was significant between all three conditions.

How did the students experience working with the representational tool? In the questionnaire, the students were asked to give their opinion about working with the representational tool. About 80%

of the students who worked with one of the representational tools ($N = 96$) thought it a useful way of working. They thought that the tool helped them to select important information for the essay and to structure this information. About 15% (5% was missing) was less positive and considered the construction of the representation as extra work, or preferred their own way of working instead of the structure offered by the representation they used. The students who worked in the Control group were asked whether they preferred the way they worked, or the way the other group of students in their class worked (they used the Matrix). One third of the 30 students who filled out the questionnaire did actually prefer to work with the matrix tool, for they thought it would be a useful way to select and organize the information.

6.5.3 Learning outcomes

6.5.3.1 Essays

As to whether the construction of different representations resulted in differences in learning outcomes, the results of the collaboratively written essays were first examined. In Table 6.8 the scores for the categories that were used to describe the quality of the essays are presented.

Table 6.8

Mean scores, standard deviations and maximum scores for the essay ($N = 65$)

Quality of the essay	Diagram ($N = 16$)	List ($N = 14$)	Matrix ($N = 18$)	Control ($N = 17$)	Maximum score
Time	4.8 (0.8)	5.4 (0.7)	5.0 (0.8)	5.4 (0.9)	6
Concept*	6.9- (1.2)	6.4-o (1.1)	6.9x (1.3)	7.3+ (1.6)	12
Change	6.1 (1.1)	6.5 (0.9)	6.8 (1.2)	6.6 (1.1)	9
Explanation	4.4 (0.8)	4.1 (1.6)	4.6 (1.3)	4.4 (0.9)	9
Standpoint	8.5 (2.5)	10.2 (2.0)	8.8 (2.2)	9.2 (2.2)	15
Source*	3.9- (1.1)	4.1- (1.0)	3.9- (1.1)	4.4+ (1.2)	6
Structure	1.9 (0.8)	1.9 (0.7)	1.9 (0.7)	1.9 (0.6)	3
<i>Total</i>	<i>36.7 (5.1)</i>	<i>38.6 (4.9)</i>	<i>38.1 (5.3)</i>	<i>39.2 (4.6)</i>	<i>60</i>

Note. Means are unadjusted means. Post hoc analysis: + sign. > -; x sign. > o.

* $p \leq 0.05$.

A MANCOVA, with the mean pair scores on the pretest as covariate, revealed a significant difference between the conditions for the quality of the essays ($F(21, 158) = 1.70; p \leq 0.05$), for the categories Concept ($p \leq 0.01$) and Source ($p \leq 0.05$). Simple contrast analyses showed that the Control condition scored higher on Concept compared to both Diagram and List. The Matrix scored also higher compared to List. With regard to the category Source scored the Control significantly higher compared to all three other conditions. The results did not indicate differences on the categories Change and Standpoint as was expected.

It was expected that the conditions in which the students had constructed an external representation would show higher scores for the essays than the control group. A possible explanation

for the fact that this expectation was not met, might be that the students who did not have to construct a representation could spend more time on writing the essay. That the students in the Control group talked more in the chat about aspects related to the writing of text (such as Text construction and Revision), could point into this direction. To check this assumption, the time spent on the different tools in the CSCL environment was distilled from the log files (see Table 6.9).

Table 6.9

Mean time (in min) and standard deviations spent in the Chat, Notes, and Essay and the results of a one-way ANOVA (N = 65)

	Diagram (N = 16)	List (N = 14)	Matrix (N = 18)	Control (N = 17)	F	p
Chat	76.3 (34.8)	71.9 (22.9)	80.5 (18.4)	85.2 (25.8)	0.50	0.68
Notes	43.4- (25.6)	61.0- (35.6)	55.6- (31.3)	93.2+ (36.4)	6.01	0.00**
Essay	49.0- (26.1)	47.1- (27.5)	55.6 (24.4)	68.8+ (20.9)	2.79	0.05*

Post hoc analysis: + sign. > -; x sign. > o.

* $p \leq 0.05$.

** $p \leq 0.01$.

If the aforementioned explanation is true, the control group would have spent significantly more time at the writing of the essay. A one-way ANOVA revealed that the conditions differed significantly on this category (see Table 6.9) and that the Control condition indeed spent significantly more time on writing the essay compared to the Diagram and List (Dunnett's C post hoc test). Moreover, the Control condition spent also more time on working in the Notes box compared to the other three conditions. In general, the Notes box was used by the individual student (it is not a shared tool) to summarize important information from the sources. However, the Notes box was also used to write (parts of) paragraphs for the essay, when the partner was writing in the text editor (in which they could not work at the same time). The fact that the students in the Control condition spent more time making notes, could actually mean that they spent more time on the writing of the essay, not only in the shared text editor, but also in their personal Note box. However, additional analyses on the content of the notes should prove this.

The representational tool was added to support students in selecting and organizing information from the sources in order to write the essay. This assumption presupposes that the items mentioned in the representation will subsequently be used in the essay. To test this assumption, the number of items in the representation and in the essay was counted, as was the amount of overlap between them. The results of a one-way ANOVA, presented in Table 6.10, and the post-hoc tests (Dunnett's C) showed that both in the List and in the Matrix more items were presented compared to the Diagram. The students in the List condition also presented more items in their essays, compared to the students using the Diagram. The number of overlap items turned out to be significantly higher for both the List and Matrix condition in comparison to the Diagram condition. The percentage of items in the representation that were also mentioned in the essay was also calculated. The List showed the highest percentage and a significant difference with Diagram. In addition, the percentage of overlap on

the total of items in the essay was calculated. It turned out that the Matrix and List scored significantly higher compared to the Diagram. In other words, the students in the Matrix and List added less new items in their essays (that were not already presented in the representation), and that students in the Diagram added more new items.

Table 6.10

Mean frequencies and standard deviations of number of items in representation and essay, number of overlap, percentages overlap on total representation item, and on total essay items and the results of a one-way ANOVA (N = 48)

	Diagram (N = 16)	List (N = 14)	Matrix (N = 18)	F	p
Representation	13.1- (3.7)	16.9+ (3.0)	18.1+ (3.6)	13.03	0.00*
Essay	10.8- (2.5)	13.9+ (3.2)	11.2 (3.3)	4.77	0.01**
Overlap	7.6- (2.5)	11.3+ (2.4)	9.9+ (2.5)	8.89	0.00**
Overlap: % of total items in representation	53.8- (16.4)	68.3+ (14.9)	55.2 (14.5)	4.07	0.02*
Overlap: % of total items in essay	69.9- (14.9)	82.8+ (14.4)	84.7+ (10.0)	6.14	0.00**

Post hoc analysis: + sign. > -; x sign. > o.

* $p \leq 0.05$.

** $p \leq 0.01$.

6.5.3.2 Pretest and posttest

In Table 6.11 the results of the individual pretest and posttest on the main items are presented, as well as the maximum scores of the items. A paired samples T-test showed that the students improved on all items of the test ($p \leq 0.05$). The only exception was that the students in the List condition did not improve on their scores on the Source item (interpretation and evaluation of the trustworthiness of two historical sources).

Table 6.11

Mean scores and standard deviations of pretest and posttest for the conditions (N = 130)

	Diagram (N = 32)		List (N = 28)		Matrix (N = 36)		Control (N = 34)	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Associations	3.1 (1.4)	5.9 (1.0)	3.1 (1.6)	5.3 (1.4)	2.6 (1.9)	5.4 (1.1)	2.0 (1.3)	5.5 (1.2)
Time	6.4 (1.6)	7.1 (1.5)	5.9 (1.8)	7.5 (1.3)	5.5 (2.0)	7.3 (1.5)	4.9 (2.5)	7.5 (1.8)
Concept	8.1 (2.7)	11.2 (2.4)	8.1 (2.7)	12.1 (2.0)	5.9 (2.5)	9.6 (2.6)	5.4 (2.9)	11.2 (4.4)
Change	2.5 (1.3)	4.3 (1.4)	2.6 (1.5)	4.6 (1.5)	1.9 (1.4)	4.2 (1.3)	1.9 (1.3)	4.5 (1.3)
Explanation	2.6 (1.9)	5.1 (2.7)	2.5 (1.8)	5.1 (2.3)	1.4 (1.7)	5.0 (2.5)	0.8 (1.1)	5.9 (2.4)
Standpoint	1.7 (1.2)	3.3 (1.9)	2.1 (1.2)	3.4 (1.4)	1.7 (1.4)	3.5 (1.4)	1.1 (1.2)	3.7 (1.4)
Source	3.4 (1.7)	4.2 (1.7)	3.6 (1.7)	4.1 (1.6)	3.0 (1.8)	4.4 (1.7)	2.7 (1.8)	4.6 (1.9)
<i>Total</i>	<i>27.8 (4.3)</i>	<i>41.1 (7.2)</i>	<i>27.9 (5.5)</i>	<i>42.1 (5.9)</i>	<i>21.8 (6.5)</i>	<i>39.4 (7.6)</i>	<i>18.7 (8.4)</i>	<i>43.0 (7.6)</i>

Note. Means are unadjusted means.

As was mentioned before, the total score on the pretest turned out to be different for the conditions ($F(3) = 16.17$; $p = 0.00$). The post hoc test revealed that the score in the Diagram and List conditions was higher than the score in the Matrix and Control condition. Therefore the *individual*

score on the pretest was used as a covariate in the analyses of the posttest. A MANCOVA with the pretest score as a covariate showed a significant effect of the conditions on the posttest scores ($F(21, 353) = 1.76; p \leq 0.05$). Significant differences at a 0.05 level were found for the variables: Concepts (defining and giving examples of historical concepts), Standpoint (providing argument for and against the statement that the sixties were revolutionary) and Source (interpretation of sources and evaluation of their trustworthiness). Simple contrast analyses revealed that both List and Control scored higher than the Matrix on Concepts and that the Control group scored higher than the Diagram and List on Standpoint and Source. Since the students in the Matrix condition reasoned more about processes of change and continuity in the chat, the Matrix condition was expected to score higher on the items about Change. However, this expectation was not met. Nor was the expectation met that the Diagram and List condition would score higher on Standpoint.

6.5.4 *Correlational analyses*

An important expectation of this research was that the collaborative construction of an external representation will result in more co-elaborated historical reasoning in the chat protocols and in higher scores for the essay and the posttest. As was shown above, analyses of variance did not confirm this assumption. On the contrary, the Control condition, which performed the task without a representational tool, showed more co-elaborated historical reasoning. However, this leaves the question unanswered whether more co-elaborated historical reasoning goes together with higher scores for the essay and higher scores on the posttest, and whether the students who constructed a representation of higher quality also wrote a better essay and performed better on the posttest. Therefore correlations were computed for the variables: co-elaborated historical reasoning, scores of the constructed representation, scores of the essay, and the scores on the posttest. Notice that the scores on the test are individual scores, whereas the scores on the other three variables are group scores. To calculate the correlations between the test scores and the other variables, the pair score was ascribed to the individual students. This results in an enlargement of the N. The results of the analyses showed no consistent outcomes for the four conditions. Two significant correlations were found. In the Diagram condition there was a significant correlation between the number of arguments in the representation and the posttest scores ($r = 0.49, p = 0.005, N = 32$). In the Matrix condition the number of utterances that belonged to co-elaborated episodes correlated significantly with the score of the essay ($r = 0.66, p = 0.003, N = 18$). More co-elaboration went together with higher scores for the essay. In the other conditions this result was not found.

6.5.5 *Prior experience with CSCL*

Some students participating in the Control and Matrix condition had prior experience with CSCL (they had participated in another research-project with a similar kind of software tool), whereas none of the students in the Diagram and List condition had this kind of experience. To determine whether this

experience may have influenced the outcomes of this study, the students of the Matrix and Control condition were divided in two new groups, the first group had experience with CSCL ($N = 46$; 23 pairs) and the other did not ($N = 24$; 12 pairs). All pairs consisted of students both with experience or both without experience. As mentioned before, the Matrix and Control condition did not differ in the scores on the pretest, and therefore t-tests for independent samples were used to test significant differences between the two groups ($p \leq 0.05$). It turned out that no significant differences were found for the following variables: (a) co-elaborated historical reasoning in the chat ($M_{\text{experience}} = 20.0$, $SD_{\text{experience}} = 23.3$, $M_{\text{no experience}} = 15.8$, $SD_{\text{no experience}} = 25.0$), $t(33) = 0.48$, $p = 0.63$, (b) the quality of the essay ($M_{\text{experience}} = 39.4$, $SD_{\text{experience}} = 4.0$, $M_{\text{no experience}} = 37.3$, $SD_{\text{no experience}} = 6.3$), $t(33) = 1.20$, $p = 0.24$, and (c) the scores on the individual posttest ($M_{\text{experience}} = 41.1$, $SD_{\text{experience}} = 7.9$, $M_{\text{no experience}} = 41.2$, $SD_{\text{no experience}} = 7.7$), $t(68) = 0.04$, $p = 0.96$. In other words, students with experience in CSCL did not score differently compared to students without previous CSCL experience. So, experience with CSCL cannot be used to explain why the Control and Matrix condition scored higher on the main variables.

6.6 Conclusions and discussion

In this article, the results of a study on the effects of the construction of external representations on the collaborative construction of historical knowledge in a CSCL environment are reported. The analyses focused on the collaborative process (historical reasoning, elaboration and co-construction in the chat), the constructed products (representation and essay) and individual learning outcomes (pre- and posttest). The results of this study indicated that a collaborative writing task in a CSCL environment is useful for promoting historical reasoning and the learning of history. All students learned from the task, as the results of the pretest and the posttest indicated. Moreover, the chat discussions and the constructed representations and essays reflected historical reasoning, although the amount of historical reasoning in the chat was less than expected. The main function of the chat in these kind of complex tasks seems to be the coordination of activities (e.g., Erkens, Jaspers, & Prangmsma, 2001). Because typewritten utterances involve a lot of effort, students might confine themselves to what is minimally necessary for the coordination of the task instead of engaging in extended content-specific discussions.

It was hypothesized that the addition of a representational tool in the CSCL environment would result in more co-elaborated historical reasoning in the chat discussion. This expectation was not confirmed. An explanation might be that both the representational tool and the chat are shared tools with (among others) the function of sharing information. By adding an argument in the representational tool, the argument is communicated to the other student and becomes part of the shared context. Therefore, it is not necessary to also share this argument via chat. The suggestion made by Suthers and Hundhausen (2003), that when one wishes to modify a shared representation one feels the obligation to discuss this first with the partner(s), was not confirmed here. The difference in

communication between the two studies, face to face in the study of Suthers et al., and chat in this study, might explain this different finding. It might be too much effort to communicate each addition or modification in the chat, whereas this might be easier in face to face communication. Thus, co-elaborated historical reasoning does not only take place in the chat discussion, but also *through* the use of the representational tools. This suggests that the representational tool does not only function as a cognitive tool that can elicit elaborative activities, but also as a tool *through which* students communicate and elaborate.

Furthermore, it was expected that the students who constructed an external representation would score higher on the essay. This expectation was also not confirmed by the results; the Control condition scored as well as, and sometimes even better than the experimental groups. A possible explanation for this outcome might be that the students in the Control condition could spend more time on the writing of the essay, since they did not have to construct a representation. The analyses of the Task acts in the chat protocols, that indicated that the students in the Control condition were more focused on the writing of the essay, point in this direction. Additional analyses on the time spent in the different tools confirmed this explanation. The students in the Control condition did not only spend significantly more time in the Text-editor, but also in the individual Notes-box. The Notes-box was probably used to write parts of the essay when the other student was working in the text editor, which were then cut and paste in the essay. Further analyses on the content of the notes should reveal whether the Notes-box was indeed used for writing parts of the essay or for other purposes, and for which purposes the Notes-box was used in the other conditions.

Another possible explanation for the fact that the experimental groups did not score higher on the essays compared to the control group, might be that students had not had enough experience with constructing an external representation, let alone enough to use this representation for writing the essay. The large overlap between items of the representation and the essay in the List condition, indicated that the list was easiest to use for text writing. The diagram seemed to be most difficult to use; there was only a small amount of overlap between items of the representation and the essay, and a lot of new items were used in the essays that were not represented in the representation. Moreover, the standard deviations for almost all the variables were high, which indicates that the variation between dyads was large. Probably, a lot of other aspects are of influence on students' behavior and learning results, such as motivation, text writing skills, and experience with CSCL. This last was ruled out by the analyses presented on prior experience.

The comparison between the three different representational formats shows that the representational notation effects the type of interaction in the chat. This finding is in line with the findings of Suthers and Hundhausen (2003). The results of the analyses show some important advantages and disadvantages of each form of representation. It was expected that the matrix would have more potential to support domain-specific reasoning, in this study especially reasoning about historical changes. This hypothesis was confirmed. The students in the Matrix condition talked most

about historical changes, a component of historical reasoning that was most important for the task that we used. Moreover, in this condition the amount of co-elaborated historical reasoning correlated positively with the total score of the essay. In the matrix most arguments were represented and references were made to almost all available sources. This finding is in line with results of the study of Suthers and Hundhausen (2003) in which the matrix group represented the most evidential relations. In this study, the matrix seems to have prompted students to fill in all available changes and continuities for which they used almost all available sources. However, this did not result in higher scores on the aspect Change in the essay and the posttest. It might be possible that the scoring of the essay was not detailed enough to catch the differences. Additional analyses of the essays showed that the students in the Matrix condition more often categorized the historical changes as political, cultural and economic, whereas students in the others conditions did less. However, this difference was not caught by our scoring of the essay. The results also indicated that a diagram is less suited for representing a lot of information. The constructed diagrams contained significantly less arguments and references to sources than the matrices and lists. A main advantage of an argumentative diagram lies in the fact that it is possible to organize the arguments graphically and to interrelate the arguments with links. However, a diagram might become too complex and too hard to organize when a lot of information has to be represented. It seemed that students in the Diagram condition had difficulties in selecting the most important information they needed for the writing of the essay. First, there was not much overlap in items in the representation and the essay and second they added a lot of new items in their essays. The results of this study also showed an advantage of constructing a diagram. In line with the expectations, in the diagrams students reached more balance between arguments pro and contra. Unfortunately, this result was not reflected in the essays or posttest.

To conclude, this study shows that a collaborative writing task in a CSCL environment is a useful task to promote historical reasoning and the learning of history. Moreover, the representational format seems to influence aspects of the collaborative learning process in a CSCL environment. The representational format seems especially of influence on aspects of domain-specific reasoning. However, this did not result in differences in learning outcomes. The representational tools did not elicit more domain-specific discussions in the chat, but were mainly used as tools through which information was communicated and shared. Continued work in this area needs to give us more insight into the support that representational tools can give, especially with respect to the domain-specific reasoning that is asked for in the task. Furthermore, more research about the role of experience with a CSCL environment and of experience with constructing and using external representations is needed.

CHAPTER 7 CONCLUSIONS, DISCUSSION AND IMPLICATIONS

This chapter provides an overview of the main conclusions of the studies. In Section 7.1 the findings of the first study (Chapter 4) are discussed and in Section 7.2 the outcomes of the second study (Chapter 5 and 6). Next, Section 7.3 elaborates on some general issues related to historical reasoning, and to the possibilities of CSCL to foster historical reasoning. Methodological issues and limitations are discussed in Section 7.4, and practical issues in Section 7.5.

7.1 Study 1: CSCL, historical reasoning, and the writing task

The general aim of the present research was to investigate whether and how CSCL can foster students' historical reasoning. In the first study (described in Chapter 4) two questions were addressed. The first and more preliminary question was: Is a collaborative writing task in CSCL a suitable task to engage students in historical reasoning? The second question addressed to in this study was: What type of inquiry question in a collaborative writing task would be especially suited to foster historical reasoning? Two inquiry questions were compared: an evaluative question ("Were the changes in the behavior of the Dutch youths in the 1960's revolutionary?") and an explanatory question ("How can the changes in the behavior of the Dutch youths in the 1960's be explained?"). In this study, ten pairs of students (pre-university education) worked together, each on his or her own computer, on a historical inquiry task, including the study of several historical sources and the writing of a text. The CSCL-environment consisted of a chat facility, a shared text editor, information sources, and a private notepad. Historical reasoning was analyzed in the collaboratively written texts and in the chat protocols. In addition, it was analyzed to what extent historical reasoning in the chat protocols was elaborated and co-constructed by both students. A pretest and post-test were administered to indicate individual learning outcomes.

The results indicated that historical reasoning could indeed be enhanced by a collaborative writing task in CSCL. Analyses of the chat protocols revealed that the students were focused on the task, since most chat utterances were related to the execution of the task. The chat protocols reflected all different components of historical reasoning, however a large part of the utterances was related to the coordination of the task. About half of the historical reasoning episodes were co-elaborated. The collaboratively written texts also reflected all different components of historical reasoning, and all individual students learned about the topic at hand, as they significantly improved on the post-test. However, although the collaborative writing task used enhanced historical reasoning in dialogue and in text writing, the amount and quality of historical reasoning both in the dialogues and in the texts

could still be improved (e.g., use of arguments to support a viewpoint, rebuttal of contra arguments, evaluation of sources, explicit use of concepts).

The comparison between the two conditions indicated that the type of inquiry question did influence students' historical reasoning in the chat dialogues, and the quality of the written texts. The evaluative task elicited, as expected, more argumentation in the chat dialogues about students' points of view, whereas the explanatory task elicited more talk about explanations. Moreover, the evaluative task not only elicited significantly more historical reasoning episodes, but these episodes also contained significantly more elaboration and co-construction. In addition, the texts in the evaluative condition were of higher quality. As was the case with the chat dialogues, the evaluative condition scored higher in the text on the aspect "point of view". Contrary, although the students in the explanatory condition discussed more explanations in the chat, they did not score significantly higher on this aspect in the text. The students in the evaluative condition, however, who hardly discussed explanations in the chat, did mention explanations in their texts. The writing of an evaluative text thus seems to include more components of historical reasoning (among which point of view, changes, explaining, and sources) than the writing of an explanatory text. The differences with regard to the aspects of explanation and point of view found in the chat protocols and text were, however, not found for the post-test.

While interpreting the results, it has to be taken into account that this study was only conducted on a small scale, and a replication of this study on a larger scale would be necessary to enable us to make stronger conclusions. However, in relation to the writing-to-learn paradigm, this study provides some evidence that collaborative writing can enhance domain-specific learning, and that CSCL can facilitate this writing process. In addition, the positive results found for the evaluative inquiry question are in line with other findings (e.g., Coirier, 1992 as cited in Coirier, Andriessen, & Chanquoy, 1999; Voss & Wiley, 1997; Wiley & Voss, 1999). An evaluative task is, compared to an explanation task, a more open task for which several (conflicting) viewpoints exist, which makes it more open for discussion and argumentation (Cohen, 1986; Coirier et al., 1999). Moreover, as also has been pointed out by Wiley and Voss, evaluation requires more personal involvement, because students have to take a personal stand, and build their own interpretation of the topic. Of course, these results do not imply that explanatory questions are not good questions to work on in educational settings. Historical explanation is an important aspect of history learning. These results mainly indicate that different questions in a collaborative writing task elicit differences in students' reasoning and learning. In this way, these findings provide additional evidence for Klein's genre hypothesis (1999; see Section 2.2.1) that suggests that the writing of different genres (in this study evaluative vs. explanatory) requires different cognitive processes and may result in different kinds of learning.

7.2 Study 2: Effects of the collaborative construction of external representations

From the first study it was concluded that a collaborative writing task in CSCL can foster historical reasoning and that an evaluative question is more powerful to enhance historical reasoning. The purpose of the second study was to improve students' historical reasoning by providing representational guidance. It was expected that the collaborative construction of different external representations would affect the type and quality of students' historical reasoning, the quality of the written texts and the individual learning outcomes. For this, three representational tools (Diagram, List, and Matrix) were compared to a control group in which the same task was carried out within the same environment, but with no additional representational tool (see Chapter 3.5 for a detailed description of the tools). In this study 130 students (65 student pairs) participated. Overall, the results indicated that the collaborative construction of a representation did affect students' reasoning in the chat dialogues, but no significant differences between the conditions were found for text quality and for the post-test. The results of the post-test also indicated that all students learned from the task. Table 7.1 summarizes the main significant differences between the conditions for the chat dialogues that were mentioned in Section 6.5 (see Tables 6.4, 6.5, and 6.6)

Table 7.1

Summary of the main significant differences in the chat dialogues between the four conditions

Variable	Diagram	List	Matrix	Control
Historical reasoning				
-Amount	-	-	+	+
-Type				
Change	-	-	+	
Time	-	-	-	+
Description	-	-0	x	+
Elaboration				
-Amount	-	-	+	+
-Type				
Question	-	-	+	+
Reasoning	-	-		+
Co-construction	-	-	+	+
Co-elaborated historical reasoning	-0	-	- x	+

Note. Only the following combinations of signs refer to significant differences: + is significant higher than - ; x is significant higher than o.

Next, the results for the three different representations and for the control group are discussed. Each section will include the results of the analyses of chat dialogues, constructed representations, and texts. Short excerpts from the chat discussions are used to illustrate the main findings (with the exception of the example of the control group, these examples are more extensively discussed in Van Drie, Erkens & Kanselaar, 2005).

7.2.1 *Diagram*

The Diagram aimed at facilitating argumentation in historical reasoning. It was expected that, by making explicit links and relations between arguments for and against, the graphical structure of the diagram would elicit students' collaborative reasoning and the discussion of different arguments and links between the arguments. As illustrated by Excerpt 7.1, the diagram did enhance the use of the terms "argument pro" and "argument contra" in the chat discussions. Although the Diagram did elicit some co-elaborated historical reasoning in the chat dialogues, it turned out that this was significantly lower than in the Matrix and Control condition, and also lower, although not significantly, than in the List condition. The expectations that the Diagram would enhance co-elaborated historical reasoning in the chat dialogues were thus not confirmed here. This finding is in line with recent findings by Munneke, Van Amelsvoort, and Andriessen (2003) who also concluded that the collaborative construction of a diagram did not result in a lot of deep argumentation in the chat discussion. On the other hand, Erkens, Jaspers, Prangma, and Kanselaar (2005) found that the construction of a diagram did have a positive effect on argumentation in the chat discussions. Since all these studies use argumentative diagrams in a writing task and were performed within the same kind of CSCL-environment (all studies used the TC3-program), it appears to be difficult to make general comments about the supporting role of a diagram and many aspects may influence the results. More research is needed to investigate under which conditions an argumentative diagram can actually support argumentation and reasoning in dialogue.

The analyses of the constructed representations indicated that a diagram is less suitable to represent much information. The constructed diagrams contained significantly less arguments and references to sources than the matrices and lists. An important advantage of the argumentative diagram lies in the fact that it is possible to organize the arguments graphically and to interrelate the arguments with links. However, a diagram might become too complex and too hard to organize when a lot of information has to be represented. This actually was the case with the task used in this study. Perhaps the results would have been different if a task had been used with a restricted number of available arguments. In addition, the students were not used to working with a diagram, which might have hindered them in an adequate use of it. This idea is supported by the fact that the chat protocols showed a relatively high number of chat utterances related to the construction of the diagram (see Section 6.5.1). Moreover, it appeared that the students faced difficulties in using the constructed diagram for writing the text. It seemed that students had difficulties in selecting the most important information they needed to write the text. Firstly, there was not much overlap in topics in the diagram and the text, and secondly, many new topics were added in the texts. In addition, problems may have arisen in converting the graphical structure of the diagram into a linear structure of the text, as the process of linearization is a difficult one (Coirier et al., 1999). The results of this study also showed an important advantage of constructing a diagram. In line with the expectations, students reached more

balance between arguments for and against in the diagrams, for in a diagram the number of arguments for and against is immediately visible. This result was not directly reflected in the scores of the texts; however, this might be due to the fact that the analyses of the text focused less on the argumentative structure (see also Section 7.4.2).

Excerpt 7.1

Fragment of chat discussion in the Diagram condition (translated from Dutch)

- | | | |
|----|---------|--|
| 80 | Bas | That thing about nozems took place in the Fifties. Did you write a lot of arguments about that? |
| 81 | Bas | I already saw one, but so that has to be a counter-argument and not one pro, because it took place in the Fifties. |
| 82 | Christa | No, is the only one. |
| 83 | Christa | But it's something of a development on the Sixties and that's very important |
| 84 | Bas | Yes but it didn't take place in the Sixties and that's the position. |
| 85 | Christa | So in that sense 60 is not revolutionary and it already started in the 50 |
| 86 | Christa | So counterargument |
| 87 | Bas | indeed I agree with you [in English] |
| 88 | Christa | Was it an argument pro at first then? |
| 89 | Bas | Yep |
| 90 | Christa | Oh, ok, that's a mistake then |
| 91 | Bas | All right, don't cry |
| 92 | Christa | I'm trying to |
| 93 | Bas | I know |
| 94 | Christa | But it's hard |
| 95 | Bas | Wanna talk about it? |

7.2.2 List

As the Diagram, the List focused on the process of argumentation, not by representing the arguments in a graphical structure, but in a more linear structure. The List did elicit discussion in terms of arguments pro and contra, but this discussion is less explicit as with the Diagram in which students had specific pro and contra argument text boxes (see Excerpt 7.2). Furthermore, similar findings as with the Diagram were obtained for the List: no significant differences with respect to the text and post-test, and less co-elaborated historical reasoning in the chat dialogues than in the Matrix and Control condition. The analyses of the constructed lists revealed some important differences compared with the diagram. Contrary to the diagram, the list did enable students to represent much information. However, this information is less structured than in the Diagram. The List has an open structure and can therefore be used in different ways. For example, some students ordered the argument in a list with arguments for and against, whereas others ordered the information according to the number of the source, and mention in brackets whether it is an argument for or against. In addition, compared to the Diagram, the list seemed more easy to use for text writing. This might have to do with the fact that students are more familiar with ordering information or arguments in a list than with making a

diagram. It resembles a way of note-taking that students practice more often. Converting information from the list into a text might also be less difficult because a list already has a more linear structure.

Excerpt 7.2

Fragment of chat discussion in the List condition (translated from Dutch)

- 130 Dorien Okay, but if we look at our standpoint, would it be a pro argument if in the Fifties a change occurred and I'm looking at source 1 then
- 131 Dorien hello????????
- 132 Pim Yes, the nozems started in the Fifties, but what was their influence in the Sixties?
- 133 Dorien a bit of consultation please I can't get it to work out....
- 134 Pim Was it large or not?
- 135 Dorien Is it positive what happens in the Fifties I don't get that
- 136 Dorien Fifties generally
- 137 Pim ehm, I think that was what gave reason to a revolution in the Sixties
- 138 Pim But do we consider the Sixties to be revolutionary or not???????
- 139 Dorien Yes well to sources 1 up to 6 arguments have to be added
- 140 Pim I do actually
- 141 Dorien shall we describe the Fifties first in the text and then go on to the Sixties and see if a lot of changes took place there and if the Fifties had an influence on the Sixties.
- 142 Dorien Yes, well, I thought the Sixties were revolutionary to you know,
- 143 Dorien I just want to set up the text right and some clarity
- 144 Pim Yes I think we should just take the Fifties in short as a starting point for the Sixties

7.2.3 Matrix

Whereas the Diagram and List both specifically aimed at supporting the argumentative process in historical reasoning, the Matrix also focused on describing historical changes and deciding to what extent each change could be labelled as revolutionary. Hence, the Matrix was expected to have more potential to support domain-specific reasoning (in this study reasoning about historical changes, especially). This hypothesis was confirmed as the chat protocols in the Matrix condition showed significantly more historical reasoning, more co-elaboration, and more talk about historical changes compared to the other two experimental conditions. Moreover, correlation analyses showed that for the Matrix condition the amount of co-elaborated historical reasoning in the chat dialogues was correlated positively with the overall quality of the text. The matrix seems to have prompted the students to fill in all the empty boxes, including a description of each change, and to answer the question whether this change was revolutionary or not. The excerpt of a chat discussion shown in Excerpt 7.3 indicates that the discussion takes place in terms of historical changes and the revolutionary impact of these changes, instead of arguments for and against as with the Diagram and List.

As the List, the Matrix enables representation of much information. The structure of the matrix seems to have prompted students to fill in all available changes and continuities for which they used almost all available sources. This finding is in line with results of Suthers and Hundhausen's study (2003) in which the matrix group represented the most evidential relations. However, compared to the List, this information is more specific and more structured. The headers of the columns in the matrix direct and constrain what is written in the boxes, and the sort function makes it possible to sort the information in different ways. The positive findings in the chat protocols did not result in higher scores on the text. And although the construction of the Matrix elicited increased talk about historical changes, and detailed descriptions of the changes and their revolutionary impact, this did not result in higher scores on the aspect Change in the text. Additional analyses of the essays, however, showed that compared to the other conditions, the students in the Matrix condition more often categorized the historical changes as political, cultural, and economic. However, the original scoring of the text did not catch this difference.

Excerpt 7.3

Fragment of chat discussion in the Matrix condition (translated from Dutch)

- | | | |
|----|-------|--|
| 66 | Rosa | I kind of expressed his opinion and told what he thought was so changeable about the Sixties |
| 67 | Rosa | I'll just put it in the matrix |
| 68 | Wilma | oh...and is that revolutionary then...? |
| 69 | Rosa | I think so because it happened rather quickly and changed a lot for the future |
| 70 | Wilma | at source 22 you mean??? |
| 71 | Rosa | no, at my own sources |
| 72 | Rosa | source 22 is rather vague to me because he mentions so many features |
| 73 | Rosa | not really a change what he describes |
| 74 | Wilma | the end of an era and the beginning of a new era |
| 75 | Rosa | that sounds pretty |
| 76 | Wilma | yeah does, but so that's a change then isn't it...? |
| 77 | Rosa | But he doesn't think it's revolutionary because he says that when it comes to representation the Sixties are heavily exaggerated |
| 78 | Wilma | that's a good one... |
| 79 | Rosa | so it's not all that much according to him |
| 80 | Wilma | I'll put that one in then |
| 81 | Rosa | that something you can work with |
| 82 | Rosa | ? |
| 83 | Wilma | Yes, that's a good answer to me... don't you think? |
| 84 | Rosa | Yes, fine, I'm not very good at source work |

7.2.4 Control group

An important assumption in the present study was that the collaborative construction of an external representation would enhance more co-elaborated historical reasoning in the chat dialogues. However, the results indicated differently; the Control condition scored significantly higher on co-elaborated

historical reasoning than the three experimental conditions (see Table 7.1). A possible explanation for this might be found in the communicative function of the representational tools, which may have resulted in less historical reasoning in the chat discussion. Both the representational tools and the chat facility are shared tools with (among other things) the function to share information and to co-construct meaning. Since no specific representational tool was available in the control condition, the only way to share and discuss information is by using the chat box and the text window. Thus, whereas the chat facility is used to share and reason about the information in the control condition, this might not seem necessary in the experimental conditions because the information is already part of the shared context provided by the representational tool. Moreover, writing messages in the chat box costs a lot of effort (Baker, 2003), and adding information to the representation and discussing it in the chat might be experienced by the students as doing things twice. This would not only explain the high amount of historical reasoning in the Control group, but also the appearance of more time references and more descriptions of historical phenomena in the Control condition (see Table 7.1). If this suggestion is true, the total amount of different topics presented either in the chat dialogues and/or representational tool have to be about the same for all four conditions. To check this assumption, the number of different topics mentioned in the chat dialogues were counted as well as the sum of the different topics represented in both the chat dialogues and constructed representations (this analysis has not been reported before). It turned out that the chat discussions in the Control condition contained significantly more different topics than the chat discussions in the three experimental conditions ($M_{\text{control}} = 6.4$, $SD_{\text{control}} = 5.7$; $M_{\text{diagram}} = 3.8$, $SD_{\text{diagram}} = 3.6$; $M_{\text{list}} = 2.9$, $SD_{\text{list}} = 2.6$; $M_{\text{matrix}} = 4.7$, $SD_{\text{matrix}} = 4.5$; $F(3, 61) = 6.2$; $p = .001$). This suggests indeed that when no representational tool is available an important function of the chat facility is to share and discuss information. However, with regard to the sum of different topics presented in both the chat discussions and the representational tools (since both are part of the same process), it turned out that significantly *less* different topics were presented in the Control condition than in the other three conditions ($M_{\text{control}} = 6.5$, $SD_{\text{control}} = 5.7$; $M_{\text{diagram}} = 13.9$, $SD_{\text{diagram}} = 3.7$; $M_{\text{list}} = 17.4$, $SD_{\text{list}} = 2.8$; $M_{\text{matrix}} = 19.1$, $SD_{\text{matrix}} = 5.7$; $F(3, 61) = 35.2$; $p = .000$). When a representational tool is available significantly more different topics are represented by chat and representation, compared to the condition without a representational tool. This suggests an important advantage of the use of a representational tool. In sum, from these additional analyses it can be concluded that historical reasoning not only takes place within the chat discussions, but also *through* the construction of a representation, and that with a representational tool a broader range of topics is presented than without such a tool. These findings also suggest that it might be more appropriate to view (and analyze) chat discussions and representational constructions as elements of one and the same process, rather than as separate items as we did in our initial analyses.

Excerpt 7.4 contains an example of a chat discussion in the Control condition that illustrates that when no representational tool is available students tend to discuss different arguments more extensively. Whereas in the Diagram and List condition students often only check each others' point

of view in the chat dialogues (e.g., “Do you think it is revolutionary? Yes, I do”), students in the Control condition not only have to check each others’ viewpoint, but also have to discuss important arguments for and against as they have not been shared yet. An additional advantage of the Matrix is that students not only discuss their viewpoint, but also discuss whether the individual historical changes can be characterized as revolutionary or not. This suggests an additional advantage of the Matrix, in the sense that the Matrix not only focuses on the overall argumentation, but also on each individual historical change, thus fostering discussion about more different aspects of the task.

Excerpt 7.4

Fragment of chat discussion in the Control condition (translated from Dutch)

- 340 Arie Okaay, I’m gainst
 341 Eva What do you think?
 342 Arie Because it’s a big change, but not in a short period
 343 Arie And the whole story already started in de 1950’s actually
 344 Eva A relatively short period of time
 345 Arie I don’t think, because in de 1950’s there are already nozems and such.
 346 Eva I think that all the changes haven’t been realized by the youth
 347 Arie So I think it’s more a logical outcome of all the (technical) developments
 348 Arie How do you mean?
 349 Eva But because of the change of the whole society
 350 Arie Okey...then how did the parents add to the changes?
 351 Eva They just changed as well
 352 Eva A very important point is the TV
 353 Eva That brought the world into the home
 354 Arie Yeah..indeed
 355 Eva So everyone got a wider world view
 356 Arie But there did arise a big generation conflict
 357 Arie Yeah..everyone..but did everyone really do something with it
 358 Eva There is a source were that generation conflict is contested
 359 Eva In the end everyone did change, I think
 360 Arie How come the youth did a lot with it, but the parents didn’t change anymore??
 Because the youth were raised in a time in which tradition and authority was
 inpopular.. while the parents were raised with traditions and authority.
 361 Eva I think there was a generationconflict for only a small part of the population
 362 Arie Have you got arguments for that?
 363 Eva But it is over emphasized by the media
 364 Eva There is another source about that
 365 Arie You’re not sure, are you?
 366 Eva Source 22
 367 Arie Letsee...
 368 Eva I think the whole society changed, especially through tv, but there was a small part
 of the youth that did not know how to cope with it, which made them really rebell
 against existing norms and values.
 369 Arie Hmm..I don’t know
 370 Eva Well aint that great
 371 Arie That the whole of society changed through tv, that I agree with
 372 Eva So that’s something we’ve got...
 373 Arie I just think they couldn’t handle everybody just accepting authority from above
 374 Arie And so they wanted to really wake people up
 375 Eva that feeling came from tv, among other things, widening everyone’s view
 376 Arie Yah...okay

Another aspect that might be related to the high amount of co-elaborated historical reasoning in the Control group is related to making references. An advantage of working with representations is that it may be easier to make references (Clark & Brennan, 1991). However, this advantage may be less strong when using on-line communication instead of face-to-face communication. In a recent study, Suthers, Hundhausen, and Girardeau, (2003) compared the effects of the collaborative construction of a graph when using face-to-face communication and chat communication. They found that in face-to-face communication gestures were used to refer to the representation, whereas in on-line communication students referred to the representation through verbal deixis and direct manipulation. Compared to face-to-face communication, students made fewer references referred less to previously added ideas, and more to ideas already in focus when communicating on-line. Moreover, students working on-line were more likely to propose new ideas directly in the graph, while in the face-to-face condition students discussed ideas proposed before the information was presented in the graph. Suthers et al. speculate that since communication in on-line settings is restricted in this way this might cause a problem for reflection on prior information and the integration of prior and new information, resulting in less extensive domain-specific discussions. This might form an additional explanation for the finding of less co-elaborated historical reasoning in the experimental conditions. However, to what extent difficulties in making references really may have influenced the present findings remains unclear, since the importance of making references is strongly related to the task and type of representation. More research is needed to gain insight into how the type of communication and the type of representational tool interact.

7.2.5 Possible influence of the year group and the length of chat protocols

As shown in Table 7.1, both the Matrix and Control conditions scored high on the variables of the chat discussion. This was expected for the Matrix condition, but not for the Control condition. Of course, the specific characteristics of these conditions might explain these outcomes (see Section 7.2.3 and 7.2.4), however, there are two aspects that might also be related to the high outcomes of both the Matrix and Control condition, namely the effect of the year group and of the length of the chat protocols.

First, since both the Matrix and Control conditions were carried out in a different school year than the Diagram and List conditions (see Section 3.2), the positive outcomes of both the Matrix and Control conditions might suggest an effect of the year group. In order to diminish differences between the students in both years, students from the same schools participated in this study. However, since randomization did not take place over the four conditions but within the two conditions of that year, differences between students in the different years might have influenced the results. A first possible difference between the years could be a difference in prior knowledge about the topic at hand, which was tested in the pretest. As it turned out the Diagram and List condition scored significantly higher

compared to the Matrix and Control condition, the scores of the pretest were used as covariate for subsequent analyses, thus ruling out an effect of prior topic knowledge. A second possible difference between the years might be found in the fact that some students who participated in the Control and Matrix conditions had some prior experience with CSCL. Additional analyses revealed that the scores of students with CSCL-experience did not differ significantly from students without experience, indicating that the difference in co-elaborated historical reasoning cannot be explained by differences in CSCL-experience (see Section 6.5.5). Although these results do not completely confirm the idea that the differences are caused by differences in year of the student groups, the effect of the year cannot be completely ruled out, since students can differ in other variables of which we do not have additional information (e.g., writing skills and cooperative skills).

The second aspect related to the positive chat outcomes of the Matrix and Control conditions, is the fact that both conditions produced significantly more utterances in the chat dialogues than the Diagram and List conditions (see Section 6.5). Thus, although students in all conditions worked about six lessons on the task, more chat utterances were produced in the Matrix and Control conditions, which might be related to the higher amount of (co-elaborated) historical reasoning. To test this assumption, additional analyses were carried out (which were not reported in previous chapters). For each dyad the percentage of co-elaborated historical reasoning utterances on the total number of chat utterances was calculated. Analysis of variance revealed no differences between the conditions. Thus, when using percentages instead of frequencies the effect between the conditions disappeared and in comparison the Control and Matrix condition did not show significantly more co-elaborated historical reasoning. This may suggest that the higher amount of co-elaborative historical reasoning in the Control and Matrix condition is related to the fact that in these conditions students produced more chat utterances. However, the question still remains why the chat protocols in the Matrix and Control conditions were significantly longer.

7.2.6 *Learning outcomes: Text and post-test*

It was expected that the collaborative construction of external representations would affect the quality of the written texts and that the different external representations would result in differences in the text. These hypotheses were not confirmed. The overall quality of the written text did not differ for the four conditions, and the hypothesis that the Matrix would score higher on Change and the Diagram and List on Standpoint was not supported by the results. Thus, the different focus of the three representations did not result in significant differences in the texts on these aspects. However, there are some indications that historical changes were categorized as political, cultural and economic in the Matrix condition, but this difference was not caught by the original scoring of the text

What are possible explanations for the fact that the construction of a representation did not result in higher text quality? It was assumed that the quality of the text would be related to the amount of co-elaborated historical reasoning in the chat. Correlation analyses only supported this assumption

for the Matrix condition, and not for the other conditions. It might be suggested that it is not so strange that the experimental conditions did not score higher on text quality compared to the Control condition. After all, the chat discussions in the Control condition contained more co-elaborated historical reasoning, and it was assumed that more co-elaborated historical reasoning in the chat discussions would contribute to the quality of the texts. However, when considering the total sum of represented topics of the chat discussions and the constructed representations, it turned out that significantly fewer topics were represented in the Control condition. It thus seems difficult to explain the quality of the text by the quality of the chat dialogues only.

Another possible explanation for the outcomes might be that the students in the Control condition could spend more time on writing the text, since they did not have to construct a representation. The analyses of the Task acts in the chat protocols, indicating that the students in the Control condition were more focused on the writing of the text, and additional analyses on the time spent in the different tools point in this direction (see Section 6.5.3.1, Table 6.9). The students in the Control condition did not only spend significantly more time in the Text editor, but also in the individual Notes box. When one student was working in the Text editor, the other could be using the Notes box to write parts of the text, which were then cut and pasted into the text. However, it has not been analyzed how the Notes box was actually used. A related aspect might be that the students in the experimental conditions did not have enough experience with using a representation for writing the text. Converting the more graphical structure of the representations into linear text may have been difficult (cf. Coirier et al., 1999; Erkens, 2004).

Since hardly any effects of the different representation tools on text writing were found, it might be suggested that the representation tools had relatively less influence on the writing product in the context of such a complex task, or that the differences between the conditions were perhaps too small to cause large differences in text quality. Moreover, it has to be kept in mind that many aspects may have influenced the quality of the written texts, which were not analyzed in the present study. Bangert-Drowns, Hurley, and Wilkinson (2004) have pointed out that the expectations and beliefs of writing mediate the effects of writing. Tynjälä (2001) has argued that students differ in their approaches to learning while writing an essay as well as in their writing strategies, both of which may influence the structure and quality of the written texts. For example, students who approach writing on a surface level may use reproductive strategies, whereas students who see writing as the construction of meaning may adopt deep-level writing strategies. Moreover, students' interpretation of text writing in history may be of influence. Greene (1994) found out that whereas students write for their teacher, professional historians write for the scholarly community, which might explain students' tendency to incorporate as many ideas as possible in their essay instead of putting forward an argument. This might also be related to students' beliefs about the domain of history; either the past is viewed as definite and historians try to find out how things actually were in the past, or the past is viewed as a

(re-) construction in answer to questions and in accordance with criteria (cf. Kuhn, Winestock, & Flaton, 1994; Lee & Ashby, 2000).

The present findings are in line with the results of a recent study by Erkens et al. (2005), which investigated the influence of different planning tools (Diagram and Outline) on collaborative argumentative text writing in CSCL. The authors concluded that the planning tool conditions did not have a significant positive effect on the quality of the texts. They argued that the availability of the tool is no guarantee of adequate use of this tool. Additional correlation analyses revealed some positive correlations between the quality of the representation and the text. For example, in the Diagram condition text quality was positively correlated with the supporting and refuting of positions and the stating of new arguments. In the present study no such positive correlations were found (see Section 6.5.4).

The results of the study also give rise to some questions with regard to collaborative text writing in a CSCL-environment and are interesting for further research. Firstly, it is important to know how the quality of the text is related to the content and structure of the external representation constructed in preparation for the text. Secondly, it is interesting to know how the quality of the chat discussion and the way the text is co-constructed affects the quality of the text. For example, to what extent do students really build upon each other's contributions while writing the text? Additional qualitative analyses comparing the collaborative process of text writing for a text of high quality and a text of low quality suggested that the degree to which students really collaborate and build upon each other's contributions in the text influenced the quality of the written product (Van Drie, Van Boxtel, & Kanselaar, 2003). However, an extension of these analyses to all participants would be necessary to know whether this is really the case.

Finally, the effects of the collaborative construction of different representations on the post-test were examined. Since all students significantly improved on the post-test compared to the pretest, it can be concluded that all students learned about the topic of the task. However, no significant differences were found between the conditions on the level of individual learning outcomes. The question rises whether the fact that the students were actively involved in sharing and organizing historical information was probably more important for learning than the differences between the conditions.

7.2.7 Conclusions and implications

This study brings us to the following conclusions. First, the representational format used shapes students' historical reasoning in the chat dialogues, and each representational tool has its' own advantages and constraints. This finding is in line with findings obtained in a recent study by Suthers and Hundhausen (2003). The comparison between the three different representational formats (Diagram, List and Matrix) indicated that the representational notation affected the amount and type of historical reasoning in the chat discussions. The Diagram and the List directed students' attention

more to the arguments for and against, while the Matrix also directed students to discuss historical changes. The construction of a matrix turned out to be especially positive, since its' structure elicited more historical reasoning (especially about historical changes) and more co-elaboration than the List and the Diagram. It has to be kept in mind that the aim of this study was not to determine which representation would be best, but to gain insight into how characteristics of the different representations would influence students' chat dialogues and the collaborative writing. Additionally, it has to be considered that the way the different representations functioned is closely related to the task, here a collaborative writing task that includes the study of multiple sources.

Second, the role of the chat discussions when using representational tools in CSCL did turn out to be somewhat different than expected at the start of this research. Firstly, coordination and management of the task figured more prominently in chat discussions than initially expected, which can be related to the complexity of the task. Secondly, as the control condition showed more co-elaborated historical reasoning in the chat, the initial hypothesis that the joint construction of an external representation would elicit more historical reasoning in the chat was not confirmed. Subsequent analysis of the diversity of topics mentioned in chats and representations, suggested a different conceptualization of their interrelations than initially adopted. Though in the experimental conditions, the range of topics discussed in chats alone was less diverse, relative to the control conditions, a combined analysis of both chat and representation showed that in sum, the range of topics in the experimental conditions was significantly more diverse than in the control conditions. It therefore appears that when a representational tool is used, the process of historical reasoning takes place not only in chat discussions, but also *within and through* the construction of the representation itself. Representing information in an external representation and communicating it through chat may well seem like doing things twice in the eyes of students, in the sense that its inclusion in the representation makes this information already part of the shared context. Our findings then also quite clearly point to a specific advantage provided by the inclusion of representations, namely a broader range of topics represented. In relation to this, the present study shows that it is important when studying the collaborative process in CSCL, to analyze dialogues in relation to the process of the construction of products, and not as distinct aspects (see also Section 7. 4). In sum, it can thus also be concluded from this study that when using CSCL historical reasoning takes place also within and through the construction of joint products, and that the addition of representational tools can result in a broader range of topics represented.

Of course, many questions regarding the construction and use of representations remain unanswered and need to be investigated in future research. Especially, the influence of different representational formats on domain-specific learning should be further investigated. The representations of the present research were selected on the basis of the subject of the task and focused mainly on the aspects of historical change and on argumentation. Which representational formats would be useful when the focus is on different aspects of historical reasoning? For example, would the

construction of a causal diagram be supportive when using an explanatory question, which was used in the first study? Moreover, it would be interesting to investigate the possible role of representations in other domains. Furthermore, in relation to the function of external representations for collaborative text writing it remains unclear how students actually make use of the constructed representation for text writing, and to what extent the representation is really co-constructed by the group of students. Do individual students have a personal preference for certain representational formats? It would be interesting to conduct a study in which different representational formats are available and to see whether they would prefer certain representation formats. And finally, what is the influence of the role of experience with CSCL and with the construction of representations for text writing?

7.3 General considerations

The sections above elaborated on the results of the empirical studies. Next, two more general issues are discussed: historical reasoning, and CSCL as a means to foster historical reasoning. These discussions also include some suggestions for further research.

7.3.1 Historical reasoning

Historical reasoning can be considered important for learning history. Historical reasoning stresses the active role of students in constructing knowledge of the past. Instead of memorizing facts and figures, students are invited to study and discuss texts and sources in order to make sense of the past. In this way, students may experience how exciting, strange and at the same time familiar the past is.

Important elements in historical reasoning are argumentation, use and evaluation of sources, use of methodological and substantive concepts, contextualization, historical change, and explanation. As is shown in this thesis, historical reasoning can be reflected in talking with peers, in writing, but also in the construction of external representations such as diagrams, lists and matrices (and also, although left out of the present research, in classroom discussions (see Leinhardt, 1997).

The different components of historical reasoning that were distinguished from the literature proved to be useful in analyzing historical reasoning in peer discussions and texts writing. However, these components must be further developed into an analytic framework of historical reasoning, in order to make progress in the design of teaching methods, learning tasks, and tools promoting historical reasoning. Further empirical evidence is needed to gain insight into whether these components indeed are important components of historical reasoning, to be used over various tasks and educational levels. Therefore, we are currently conducting a study in which students of various levels as well as expert teachers perform various history tasks (Van Boxtel & Van Drie, in preparation). By analyzing and comparing both students' and teachers' reasoning in different tasks, we aim at developing a framework for analyzing historical reasoning. Not only should this model be

useful in analyzing historical reasoning, but it should also show how the different components are related to each other. Moreover, the model should be not only useful in analyzing historical reasoning in school situations, but also outside school in everyday life situations, for instance when reading newspapers, visiting museums, watching movies and playing simulation games.

The present study showed that CSCL can foster students' historical reasoning, and that this reasoning is mediated by characteristics of the task and the learning environment. The type of question to be answered and the characteristics of the external representations used, influence the amount and type of historical reasoning. The detailed analyses of students' collaborative historical reasoning in CSCL reflected all different components of historical reasoning and students frequently talked about historical changes and about their viewpoint (both important aspects of the task). However, they talked less about explanations and about the sources. Although the evaluation of historical sources is part of the Dutch history curriculum, students do not seem to do this automatically in the context of a historical inquiry, not even when the sources reflect different viewpoints on the historical issue, as was the case in this study. The finding that talking about sources did not often occur, might be related to the fact that students find this difficult to do (Wineburg, 1991a). Furthermore, as was revealed by the first study, historical concepts were not often used explicitly in the chat discussions. However, it also turned out that when historical concepts were more explicitly used, this resulted in better scores on these concepts in the post-test, suggesting that the use of concepts contributes to the learning of these concepts.

Though research into learning and teaching history is growing internationally, there is still much to be explored, including topics like the role of new technologies in facilitating historical reasoning, tasks promoting active knowledge construction of the past, discourse patterns in students' dialogues and whole class discussions, the role of different kinds of representations (see Prangmsma, Van Boxtel, & Kanselaar, in preparation), the role of ideas about the past gained outside school, and the use of different kinds of sources, including audiovisual ones (see Klein, 2005). In addition, insights into how students learn history should be linked to teaching practices (Wilson, 2001).

7.3.2 CSCL as a means to foster historical reasoning

To what extent can CSCL facilitate and enhance historical reasoning? From this study it is concluded that CSCL can indeed facilitate historical reasoning by means of on-line dialogues and the construction of shared products. Moreover, this study showed that especially an evaluative inquiry question and the construction of a matrix have the potential to elicit historical reasoning in a collaborative writing task. However, although the chat discussions reflected all different components of historical reasoning, the overall amount of historical reasoning in the chat dialogues was somewhat less than initially expected. In Section 7.2 we discussed the amount of historical reasoning in relation to the different conditions, however, more general aspects (which means related to all the four conditions) may have been of influence here as well. First, writing messages in the chat discussions

cost a lot of effort (Baker, 2003) and students might think it is too much trouble to have extensive written discussions in the chat sessions. Second, students seem to tend to be more focused on the product than on deep learning (Veerman, 2000). In addition, as pointed out by Erkens, Jaspers, and Prangma (2001), it is necessary to establish agreement in a collaborative learning task; therefore, students will try to reach agreement and will not often be very critical with regard to each other's contributions, which may result in less extensive chat discussions.

Third, the results of this study also indicated that an important function of the chat facility is the coordination and management of the task. This is in line with results found in several other studies (e.g., Baker, de Vries, & Lund, 1999; Erkens et al., 2005; Munneke et al., 2003). It might be suggested that due to the necessity to coordinate the activities in such a complex task as used here, there is less space for domain-specific discussions. In addition, the relatively low experience of the students with CSCL might be of influence too. It would be interesting to investigate whether students who are more experienced with these kinds of tasks in CSCL would spend less time on coordination and task management, and more time on content-related discussions. The question, however, remains whether we, as researchers, have too high expectations of student conversations in these kinds of tasks and environments. And is it really necessary for the accomplishment of the task to have more extensive discussions? Conducting this study with for example historians who have experience with CSCL, and comparing the outcomes with the present ones, would in this respect be interesting.

Finally, it is important to consider the cognitive load that imposed on the students by this task (Sweller, 1988; Sweller, Van Merriënboer, & Paas, 1998). As has been set out before, writing an argumentative text on the basis of multiple sources is a complex task involving many cognitive activities. Comparing and combining information from different sources, identifying different viewpoints and related arguments, taking an own point of view, constructing an external representation, writing an argumentative text, and all this in collaboration with a peer student and communicating by means of a chat facility, is quite some task to fulfill. The intrinsic cognitive load imposed on the students by this task may be heavy in itself, since many different aspects are interrelated (Sweller et al.). One of the functions of an external representation is that of external storage, thus reducing extrinsic cognitive load (Benton, Kiewra, Whitfill, & Dennison, 1993; Lethinen, Hakkarinen, Lipponen, Rahikainen, & Muukonen, 2001). In the present task, the representation can function as external storage and can help to select and organize the information of the different sources. However, the collaborative construction of external representations may also increase cognitive load for several reasons (Van Bruggen, Kirschner, & Jochems, 2002). Firstly, the characteristics of external representations may add to the coordination problem (which may be supported here by the large amount of coordination in the chat discussions). Secondly, the collaborative construction of a representation requires the representation to be readable and understandable by the other, which brings additional cognitive costs (Cox, 1999). Thirdly, within CSCL different representations need to be coordinated, which requires students to understand relations

between the different representations (Ainsworth, Bibby, & Wood, 1998). Thus, the addition of the joint construction of a representation may have increased, instead of decreased, the cognitive load.

Whereas the outcomes of this study put into perspective the importance of the chat dialogues, the importance of the joint construction of products for fostering historical reasoning was highlighted. In the joint construction of products, students share important information and organize this information into a given format. Much historical reasoning thus takes place in the construction of these products. Moreover, the presence of a representational tool resulted in a broader range of topics represented. An additional advantage compared to communication by a chat facility, is that communication through the construction of products is more structured, in the sense that more relations between the information can be established. On the other hand, a constraint is that this communication takes place in a somewhat implicit way; it remains unclear to what extent a shared understanding between the learners is really established.

To conclude, the present research showed the facilitating role of CSCL in fostering historical reasoning in a writing task involving the study of multiple sources, and through the construction of external representations. Of course, this is only one possible task that may foster historical reasoning in CSCL. It would be interesting to investigate the extent to which other kind of tasks can elicit historical reasoning in CSCL, for example the joint construction of a website or an on-line exhibition, or through on-line role play.

7.4 Methodological considerations

Although in the sections above some methodological issues have already been mentioned, this section specifically elaborate on several methodological aspects of this study. These include the design of the study, the instruments and analyses, and the extent to which the present findings can be generalized.

7.4.1 Design of the study

The present study investigated the effects of the collaborative construction of different representations on historical reasoning in dialogue and writing, by analyzing both the process and the products of the collaboration. Three different representational tools were compared with one another and with a control group. Not many studies (in CSCL) systematically compare the effects of different representations, and additional comparisons with a control group have (as far as we know) hardly been conducted. However, such an approach proved to be a useful one, as in comparison with other representations and with a control group, the effect of the representational formats becomes explicitly clear. Hence, when investigating the influence of representational tools in CSCL, comparing different representations with a control group may provide interesting insights.

On the other hand, it might be suggested that, since the task involved many different aspects, the differences between the conditions might be relatively too small to expect large differences on a strict measure as the variable “co-elaborated historical reasoning”. Moreover, since so many activities were involved in this complex task, it might be difficult to subscribe the outcomes only to characteristics of the representational tools. Although we tried to analyze both the process and the products of the collaborative process in this study, many other aspects may have influenced the present outcomes. These aspects may, among others, include writing skills, collaborative skills, experience with external representations (for text writing), CSCL-experience, task approaches, beliefs about the nature of history, and group composition. In addition, the relational dimension of the collaboration received less attention in this study, although this is an important prerequisite for good collaboration (Barron, 2003; Kreijns, Kirschner, & Jochems, 2003). Furthermore, the high standard deviations found for the different categories in the chat discussions indicate a high within-group variability, suggesting that other factors than the conditions were of influence on the quality of the chat dialogues. This study revealed that a complex interplay exists between characteristics of the task, the learning environment, external representations, and the students; all these might influence students’ interaction processes and learning (cf. O’Donnell, 1999; Schnotz & Lowe, 2003; Van Boxtel, 2000). Therefore, it is difficult to investigate the effect of one (or more) particular aspect. This study shows again that it is quite difficult to unravel the process of learning in an interactive situation.

7.4.2 *Instruments and analyses*

Both the process and products of collaborative learning were analyzed in this study, and the analyses included qualitative and quantitative methods. Detailed analyses of chat dialogues were combined with analyses of the products of collaboration and individual learning outcomes. However, in the reported studies more emphasis is given to quantitative measures. Additional qualitative analyses could provide more insights into, for instance, how and to what extent students collaboratively co-construct a representation and a text, and how the constructed representation is used for text writing. Preliminary analyses turned out to be promising (cf. Van Drie, Van Boxtel, & Kanselaar, 2003). Moreover, qualitative case studies might reveal important processes that can then be analyzed in a quantitative way on a larger scale.

Still, the analyses used in this study also have some constraints. The analyses included the chat discussions, the constructed representations and the texts; however, these were analyzed as separate items. In this way, the construction processes of the representation and the text were only examined by analyzing the related chat discussions, thus leaving out what additions or deletions were made in the representation and the text. As this study revealed that the interaction process takes place not only in the chat discussion, but also through the construction of the joint products, it might be more appropriate to view chat discussions and representational constructions as elements of one and the same process, rather than as separate items as we did in our initial analyses. We therefore suggest

that a more holistic approach, including the construction process of representations and texts as elements of one and the same collaborative process, rather than as distinct from chat discussions, should be the focus of future research. The constructs “historical reasoning”, “elaboration” and “co-construction” might be used to analyze the collaborative process, as it takes place in the chat discussion and through the construction of joint products as part of an integrated process. Interaction analyses, such as the Rainbow method (Baker et al., submitted; Munneke et al., 2003), represent an important step forward in this respect, for communication and actions within the learning environment are analyzed as part of the same collaborative process.

With regard to the analyses of the text, this study showed that the analysis of texts is difficult, since it is rather interpretative. The scoring of the texts included the different components of historical reasoning. Thus highlighting domain-specific reasoning, other aspects of text writing in history received less attention, e.g. detailed analyses of the argumentative structure, and the way in which the sources were referred (cf. McCarthy Young & Leinhardt, 1998; Rouet, Marron, & Mason, 1993).

7.4.3 *Generalization of the findings*

To what extent can the findings of the present studies be generalized to other domains, tasks, participants or learning environments? This study was carried out within one domain, one task, one educational level, and one specific CSCL-environment. Therefore caution should be taken in generalizing the present findings. Firstly, it has to be taken into account that this study was conducted within the context of CSCL, and more specifically within the use of the TC3 and VCRI-environment. Specific characteristics of this environment, and especially the use of a chat facility may have been of influence here. An interesting line of research would be to make a systematic comparison of the effects of the construction of a representation when using different types of communication (i.e., face-to-face communication, synchronous and asynchronous communication). This would shed more light on the way the representations function in relation to the type of communication, for instance whether it is easier to refer to parts of the representations in face-to-face settings, and whether one is more inclined to directly explain changes made in the representation in face-to-face than in on-line communication.

Secondly, the effects of representational tools on students’ historical reasoning in chat discussions and text writing were examined in this study. The topic of the task, the type of question to be answered, the fact that it concerns a writing task, and the representations used, all had their impact on the chat discussions and text writing. In order to draw a more general conclusion about the effects of representations different questions can be asked to be further investigated: What is the effect of a diagram, list and matrix when using a different topic in history? Which representations can be used for different inquiry questions, for example the explanatory question used in study 1? What is the effect of different representations for different kind of tasks (not text writing)? In addition, since research on representations is often conducted in science domains, more research is needed on the role of representations for domain-specific reasoning in domains such as history, geography, and economics.

Finally, this study is conducted within the domain of history. Caution should be taken to generalize the outcomes on historical reasoning to other domains, especially since one of the assumptions of this research is that reasoning differs in certain aspects for different domains. However, the present approach of analyzing the interaction process by focusing on domain-specific aspects, elaboration and co-construction nicely shows how students interact with one another. Moreover, identifying different components of historical reasoning and using these components as a frame of analysis turned out to be useful in order to gain insight into how students reason in the domain of history. A similar approach in which important components of reasoning in a domain are identified may also be useful to gain insight into how students reason in other domains.

7.5 Practical implications

What are the practical implications of the present study? Although the present study offers some interesting ideas for educational practice, it should be kept in mind that this research was essentially theoretically driven. Hence, it is difficult to offer many clear-cut implications for implementation and instruction. However, some insights certainly have value for (history) education and might offer inspiration for teachers and educators for further development. This section focuses first on the use of representations in a collaborative writing task, next on CSCL and active and self-directed learning, and lastly on teaching students historical reasoning.

7.5.1 *The use of representations in a collaborative writing task*

This thesis demonstrates collaborative writing (within CSCL) to be a useful strategy to engage students in historical reasoning, and especially a writing task on the basis of the study of multiple sources, as it requires students to analyze and synthesize information from various sources into a coherent text. As this study revealed more in particular, addressing an evaluative question appears to be the most promising strategy to elicit co-elaborated historical reasoning. Obviously, this does not imply that questions asking for a description or an explanation should not be used in history education. What questions are addressed will depend on the goals at hand; when these include the elicitation of elaborative discussion between students, then posing evaluative questions is a useful strategy. In cases where this goal is combined with the task of explaining an historical issue or event, reformulating the explanatory question into an evaluative question should be considered. For example, the question “What are the causes of the changes in the behavior of Dutch youths in the 1960’s” could be reformulated as “What is the *most important cause* of the changes in the behavior of Dutch youths in the 1960’s?” In this way, chances of eliciting discussion between students would be higher, for it forces them not only to express their opinion, making them are more personally involved, but also to

think of arguments in favor of their opinion, to refute counterarguments, and to weigh different opinions.

Our study shows that collaboration on a writing task enables students to discuss, amongst other things, the structure of the text, the content (for example the interpretation of the sources), and the generation and organization of different arguments. Other possibilities to integrate writing and collaboration, besides co-authoring a text, would include activities such as individual writing combined with discussing (individually) constructed representations in dyads, small groups, or in classroom discussions, individual writing combined with the collaborative construction of a representation in dyads, discussion of different viewpoints in small groups or whole class discussions, and/or giving peer feedback on a first draft of the text.

In this thesis, the collaborative construction of representations was adopted as a strategy for the planning phase of the writing process, in order to help students to select and organize the information from various sources. Questionnaire results showed many students to acknowledge the usefulness of this kind of help. Though the construction of a representation was studied here in relation to a writing task, it could very well be a useful task in itself, either in individual or collaborative settings, for instance in the form of a concept map or a time line, or as the basis for a classroom discussion (e.g., Barnes, 2003; Van Drie & Van Boxtel, 2003). For our study, we selected three representational formats to support a writing task addressing an evaluative question concerning historical change. The specific advantages and constraints of the diagram, list and matrix in relation to an evaluative question have been set out before (see Section 7.2) and will not be repeated here. Since various representational formats are possible to support different writing tasks (see Counsell, 1997), it is important to think about what representational format would be best in relation to the task at hand. The choice of a representation is as this study indicated (and among others) related to the goal of the task (e.g., What components of historical reasoning are important in the task?), and the number of sources used (e.g., Is the representation suited to represented much information or not?).

This study also showed that the construction of a representation might be difficult for students, especially when the format of the representation is less familiar to them, as appeared to be case with the diagram. Moreover, problems may arise in converting the more graphical structure of the representation into the more linear structure of the text. It has been argued that students need to be instructed in the construction, and also in the adequate use of an external representation (Cox, 1999). Although a collaborative writing task, including the study of multiple sources and the construction of a representation can be done without the use of computer technology, using computer technology makes it more easily possible, because the different learning activities can all be carried out within one single learning environment and it makes the joint construction of, for instance, a text or representation easier to do, as it facilitates making additions to or modifications of the product.

7.5.2 *CSCL and active and self-directed learning*

CSCL fits within a constructivist view of learning, and offers a learning environment for active and self-directed learning. It enables students to choose their own place and time of work. In addition it enables students to collaborate on assignments (e.g., inquiry tasks) that require prolonged periods of work, across several lessons. In this study we particularly investigated the role of synchronous communication, and consequently students were only required to work on the task at planned hours. Collaborating with a partner, who sits in a different computer lab, was experienced by students as somewhat artificial. Using asynchronous communication as an additional form of communication would allow students to collaborate at their own time. More recent versions of the VCRI-program offer possibilities for both synchronous and asynchronous communication, and for the teacher to monitor the learning process (Janssen, Erkens, Kanselaar, & Jaspers, 2005, submitted).

As the role of the teacher in this study was deliberately limited to help with technical problems, students in this study worked on the tasks without the help of a teacher. This forced them to solve content-related problems by themselves. The participating teachers were very pleased with the way students worked on this assignment by themselves, chat discussions indicated that most students were very much on-task, and questionnaire results showed that most students did not feel the need for extra help, and considered themselves well able to accomplish the assignment without the help of the teacher. All in all, this suggests that the learning setting created here is a good example of active and self-regulated learning. Using CSCL requires adaptations in the role of the teacher. Though for our study the teacher role was deliberately limited, in general the teacher will retain an important role in guiding the learning process of the students, improving historical reasoning, providing feedback in different stages of the learning process, and in modeling how to construct a representation and use this representation for the writing of a text. In addition, CSCL provides various opportunities to incorporate classroom discussions, for instance to discuss the constructed representations or after performing the task and/or the test, as one of the participating teachers actually did. This enabled many students to actively participate in the discussion, since they all had extensively studied the subject and formed their own point of view, and it enabled the teacher to draw some important historical lines.

7.5.3 *Teaching students historical reasoning*

Although there is progression in this field, a pedagogy of the more general use of computer technology in history education is still lacking. Nevertheless, using computer technology does provide teachers and educational designers alike with the challenge and opportunities to design and bring into practice collaborative learning tasks that elicit historical reasoning.

In this thesis historical reasoning has been described as an important activity for history learning. Focusing on historical reasoning may offer an interesting approach to history learning and teaching, especially when more emphasis is given to the active role of students in constructing knowledge, which is in line with recent more constructivist views of learning. While the different

components of historical reasoning (i.e., argumentation, source use, contextualization, explanation, description of changes, and use of concepts) formed important ingredients of our framework for the analysis of historical reasoning for research purposes, we suggest it is also a useful scheme for the development of tasks that provoke (specific components of) historical reasoning, and for assessing students' historical reasoning abilities.

With regard to students' historical reasoning it should be kept in mind that reasoning in history is quite complex. As this study showed, students at a pre-university level are able to reason about the past, but they also displayed problems with evaluating sources, discerning different interpretations of the past and weighing different arguments, and they did not often explicitly use more abstract historical concepts, both methodological and substantive. A possible explanation for these problems is the fact that participating students did not have much experience with writing tasks in history, and did not receive explicit instruction for this. Several authors have suggested that explicit instruction might improve the quality of writing and collaborative reasoning (e.g., De La Paz, 2005; O'Donnell, 1999). Recently, De La Paz found that even low ability students significantly improved their performance in text writing and historical understanding with extended instruction in both historical reasoning and argumentative writing. How to provide instruction on historical reasoning goes beyond the scope of this research project; it merely demonstrates the power of tasks and tools in eliciting it. Teaching students to reason in history is a challenging job, which may take much time in an already time-limited practice of teaching several classes for only a few hours a week, put high demands on the reasoning skills of the teacher, may be difficult and time-consuming to assess, and which requires good instructional materials and learning tasks. (cf. O'Reilly, 1991).

Finally, computer technology is changing history education, in the sense that a huge amount of information is becoming accessible to students and teachers through the internet (e.g., the "Teleblik project", see www.teleblik.nl) and CD-ROMs. This development raises the question how to prevent students from using a "cut-and-paste" approach to information. After all, in order to develop students' understanding in history it is important that they learn to analyze and deploy information after they have accessed it (Haydn, 2000). In this study, the computer learning-environment used in this study, was especially designed to elicit the latter processes of learning, which proved successful to a considerable degree. It shows that a CSCL-environment not only stimulates collaborative learning processes as such, but can also be geared toward domain-specific knowledge production. By integrating reading activities, group discussions and different ways of representing knowledge in one single environment, the CSCL environment contributes to the active and joint construction of knowledge. In sum, CSCL fosters historical reasoning and this process of historical reasoning is mediated by the question addressed, the representational tools applied, and the type of products asked for and constructed.

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APPENDICES

Contents appendices

Appendix A: Assignment and description of the information sources used for the task

Appendix B: Test

Appendix C: Questionnaire

APPENDIX A The task**Assignment: “The roaring Sixties?!”**

The Sixties of the 20th century are still quite popular: music and clothes of these years appeal to young and old. The 1960’s are sometimes called “the roaring Sixties”. Some state that in these years many changes took place in Dutch society. Others argue that the Sixties were not that revolutionary, and that few things changed.

You are conducting an inquiry into the question:

Were the changes in the behavior of Dutch youths revolutionary?

In order to find an answer to this question, you will together carry out an historical inquiry. You can use the information from the sources. Firstly, you collaboratively collect arguments for and against in the Diagram. Next, you collaboratively write a text in which you give a founded answer to the question. Use arguments for as well as arguments against (see the assessment criteria).

The text must contain 750 – 1,000 words. Where appropriate refer to the sources (for example when you quote someone, or when you refer to the opinion of an historian). You have six lessons to complete this assignment.

The assignment consists of the following steps:

- Step 1: Both of you read source 0; it contains general background information concerning the 1950’s and 1960’s.
- Step 2: Study the sources. You can divide the sources between the two of you (Suggestion: a division in even and uneven numbers leads to a balanced division of the information).
- Step 3: Select arguments for and against in the diagram. You hand in the constructed diagram by the end of the fourth lesson. The constructed diagram will be part of your grade.
- Step 4: Next, you collaboratively write a text in which you answer the question. The text must be handed in by the end of the sixth lesson.

NOTE: Do not start writing the text before you have finished the construction of the diagram.

Table of Contents: Information sources

Number	Title	Type of text
0	Background information Containing information about - the 1950s and 1960s - two descriptions of the concept 'revolution'	Descriptive text
1	"Nozems eisen het volle pond" [Nozems want it all] Fragments of a article by Jan Vrijman about Nozems (1955)	Article in a journal: Vrij Nederland, 03-09-1955
2	Working youth in the 1950s	Descriptive text
3	Leisure time in the fifties	Descriptive text
4	Family life in the 1950s	Photograph and text
5	Prolonged education for youngsters	Descriptive text and table containing percentages students 1950-1973
6	Youngsters in the 1950s-1	Descriptive text
7	Youngster in the 1950s-2	Two photographs of young people hanging in the street and listening to a jukebox
8	Television in the 1960s	Descriptive text
9	Popmusic in the 1960s	Descriptive text
10	A girlsroom in the 1950s and 1960s	Two photographs.
11	Attitude of youngsters towards sexuality in the 60s	Descriptive text
12	Emancipation of women: "Man Vrouw Maatschappij" and "Dolle Mina"	Descriptive ext
13	The magazine "Margriet" on the position of women in society	Text and a quote from the magazine (1965)
14	Provo	Descriptive text
15	Amsterdam in the 60s	Descriptive text
16	Conflict between generations	Descriptive text
17	Provo in photographs	Three Photographs
18	Political ideas of youngsters in the 60s	Descriptive text
19	Interview with Ms v.D. who moved from Amsterdam to the countryside in 1965	Interview
20	Historian Blom about the changes in the 60s	Interpretation of a historian
21	Historian Kennedy about the conflict between generations	Interpretation of a historian
22	Historian Pas about provo	Interpretation of a historian
23	Historian Righart about the sixties	Interpretation of a historian
24	Historian Stuurman about the changes in de 50s	Interpretation of a historian
25	Sociologist Wilterdink about the representation of the youth of the sixties	Interview

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APPENDIX B The test*

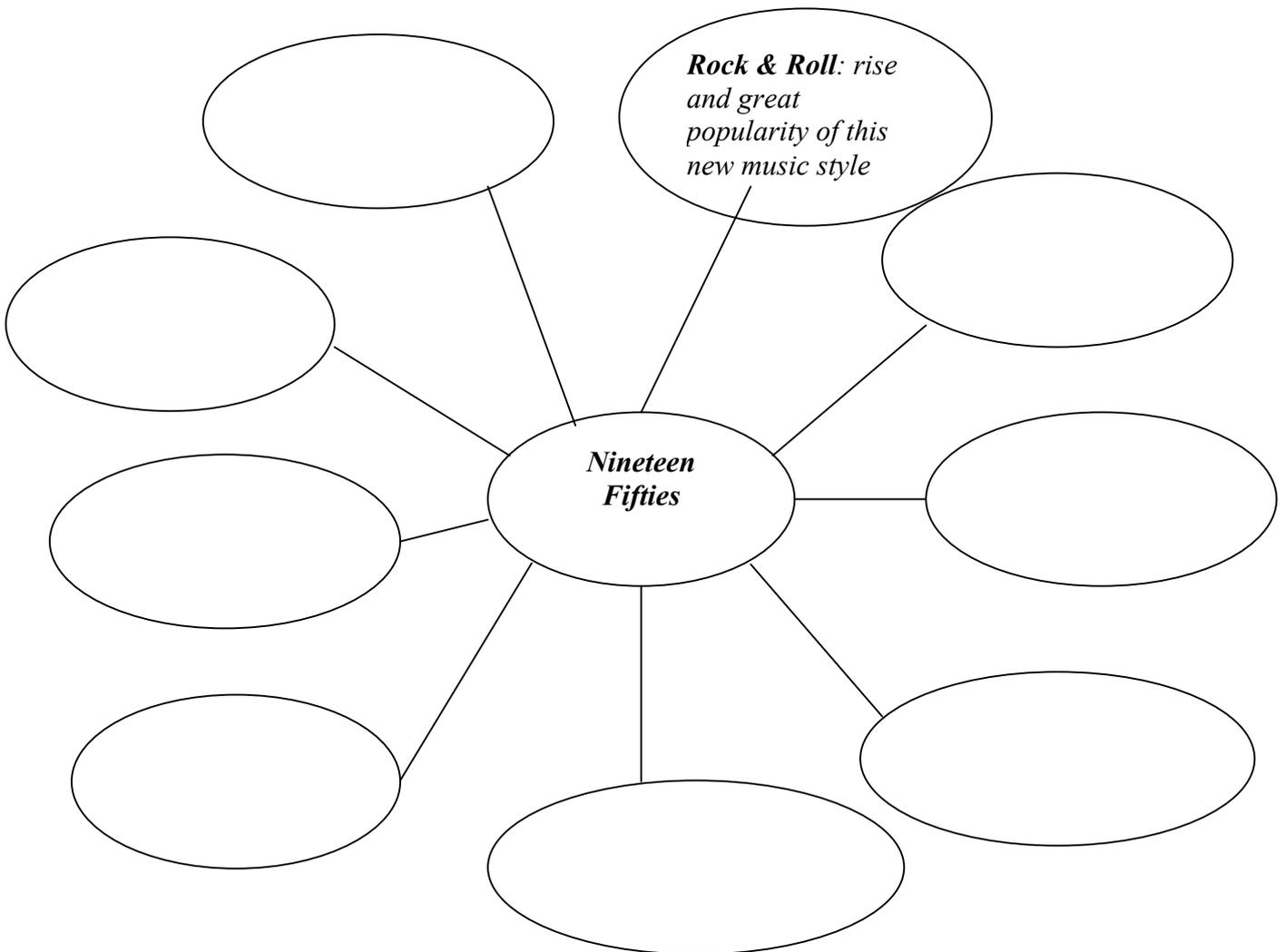
TEST Part 1

Name:
School:

Class:
Date:

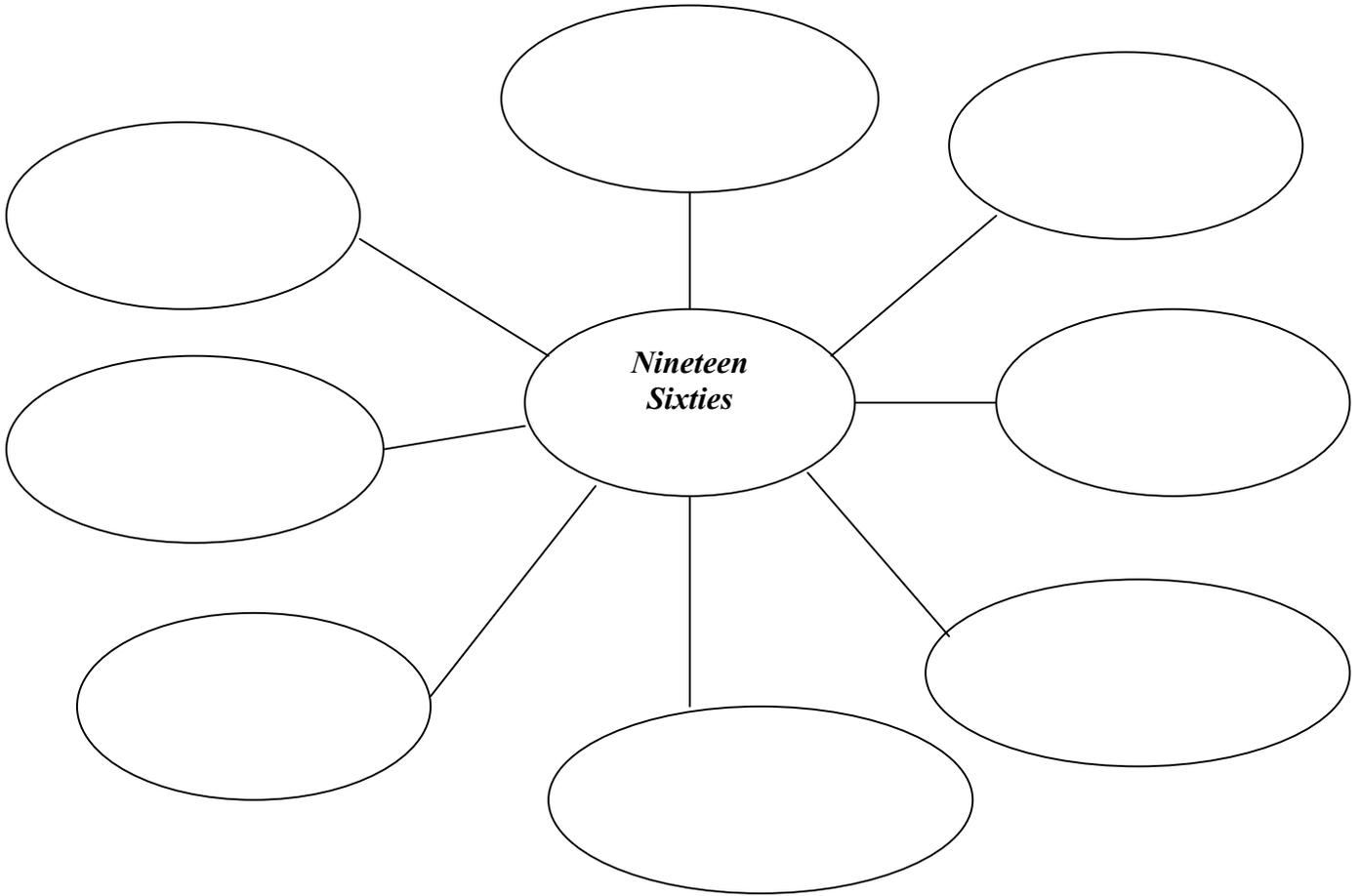
This test consists of two parts. When you have finished part 1, you can hand it in and you will receive part 2. Note: there are questions on both sides of the pages. Good luck!

1a. What comes to your mind when you think of the 1950s in the Netherlands? Write this in the circles below. First, write down a word or concept, then make a sentence. See the example below. If you are not able to fill in all the circles, you can leave some of them empty.



* This is an example of the post test, the pretest was the same as the post test.

- 1b. What comes to your mind when you think of the 1960s in the Netherlands? Write this in the circles below. First, write down a word or concept, then make a sentence. If you are not able to fill in all the circles, you can leave some of them empty.



Ready? Please hand in part 1. You will receive part 2 of the test.

TEST Part 2

Name:
School:

Class:
Date:

Part 2 consists of 7 items (2 – 8c). Please answer the questions in the given order. Good luck!

2. Are the following concepts and phenomena more characteristic for the 1950s or for the 1960s. Put a cross in the column you think each concept or phenomenon belongs to. If you do not know the answer, you can put a cross in the column “don’t know”.

	1950's	1960's	Don't know
a. first naked woman on tv			
b. Elvis Presley			
c. criticism on authorities			
d. a man with long hair			
e. nozem			
f. rise of the refrigerator and washing machine			
g. New Left coming into existence in the Labor Party			
h. rise of income of youths			
i. Second Women's Liberation Movement			
j. White Bicycle plan			

3. Explain the following concepts.

a. Nozem:

b. Provo:

c. Dolle Mina:

d. Revolution:

APPENDICES

- 4a.** Make clear by using a concrete example that in the 1960's a process of individualization took place. Make sure that the meaning of the concept becomes clear in your answer.
- b.** Make clear by using a concrete example that in the 1960's a process of democratization took place. Make sure that the meaning of the concept becomes clear in your answer.
- c.** Make clear by using a concrete example that in the 1960's a process of depillarization took place. Make sure that the meaning of the concept becomes clear in your answer.
- d.** Make clear by using a concrete example that in the 1960's a process of women's liberization took place. Make sure that the meaning of the concept becomes clear in your answer.

APPENDICES

5a. Mention as many (with a maximum of 10) features as possible of youths in the 1950s.

5b. In the 1960s the behavior of youths changed. What was new in the behavior of youths in these years? Name as many changes as possible (with a maximum of 10).

- 6a.** What causes the changes in the behavior of youths in the 1950s and 1960s? Mention as many causes (with a maximum of 5) as possible. Explain each cause briefly!

Do it in this way:

Cause 1:

Explanation:

- 6b.** Choose the cause you think is most important from the causes you mentioned in question 6a. Please explain why you think that this cause is the most important.

I think that cause (fill in the number) was the most important one, because....

APPENDICES

7a. Imagine there is a debate in your history class about the claim: “In the 1960s the behavior of youths changed in a revolutionary way.” What standpoint will you take? Write down whether you agree with the claim or not, and support your standpoint with arguments.

7b. A girl from your class does not agree with you. Which arguments could she use to defend her point of view? (This means that, if you first agreed with the claim, you now provide arguments against. If you first disagreed with the claim, you now provide arguments in favor of the claim, of course).

8. Read source 1 and source 2.

Source 1

Ex-provo Roel van Duyn about the 1960s:

And yet something has changed. A generation has grown up which does not have the uncritical regard for power. People with power are looked at differently since the Sixties; no longer as “they”, as those who determine what happens without opposition. A climate in which deviating life styles could cautiously come into existence evolved from the existing societal pillars in the Sixties. In the Netherlands, one can be gay, a married catholic priest or a houseman, or even without a profession, since the Sixties.

G. Harmans (red.) (1991). *Weet je (nog) wel: de jaren zestig*.

Source 2

Historian Pas about the 1960s:

The form in which provo manifested itself (happenings, playful actions, pamphlets) may have been new, but the movement was firmly rooted in the past, both ideologically and with regard to value patterns. The belief in progression and the resistance against all kinds of aspects of the modern times were strongly mingled in provo. Sexual freedom was welcomed, but consumer goods were cursed. They criticized television because it was said to have an estranging effect. But at the same time they could not do without television to propagate their actions. The cliché image of the Sixties as a radical, isolated period – with provo as its representative – can no longer be maintained.

N. Pas (2001). De jaren zestig geprovoceerd. In: *Kleio* 42(2), 16-20.

a. Van Duyn claims (Source 1) that the 1960s were a revolutionary period. Which arguments does he use to support his standpoint?

b. Does historian Pas agree with Van Duyn? Which arguments does he use to support or contradict Van Duyn’s standpoint?

Pas agrees/disagrees with Van Duyn. (strike out the wrong option).

He uses the following arguments:

c. Do you think Source 1 is reliable enough to answer the question whether the changes in the Sixties were revolutionary? With which of the three answers below do you agree? Explain your answer.

I think source 1 is reliable, because

I think source 1 is not reliable, because

I think source 1 is on the one hand reliable and on the other hand not, because (Note: Explain both aspects)

APPENDIX C Questionnaire

Name:.....

School:.....

*Check the answer that fits you best**Note: You must write down an additional answer with some questions.***Domain of history**

1. I think history is an interesting subject.

 agree partly agree partly disagree disagree

2. I think history is a difficult subject.

 agree partly agree partly disagree disagree

3. I think that the topic of the task was interesting.

 agree partly agree partly disagree disagree

4. Through this assignment I have learned much about the 1950s and 1960s .

 agree partly agree partly disagree disagree**Task**

5. What do you think about the following parts of the task?

a. The task was

 easy average difficult

b. The research question was

 clear not clear, because

c. The criteria for assessment were

 clear not clear, because

d. The number of lessons to accomplish the task was

 sufficient not sufficient

e. Only for the Matrix group: I liked describing the changes first.

 agree partly agree partly disagree disagree

f. The total number of words of the text was

 sufficient not sufficient

g. The total number of sources was

 sufficient not sufficient

h. The sources contain adequate information

 sufficient not sufficient

i. The content of the sources was

- easy average difficult

6. This task could be accomplished without help on a content level from the teacher.

- agree partly agree partly disagree disagree

7. Were there any moments you needed content help from your teacher?

- yes no

When your answer was 'yes', do you remember what you wanted to ask?

.....

8a. Did you work with

- the diagram (please continue with 8b and skip 8c)
 the list (please continue with 8b and skip 8c)
 the matrix (please continue with 8b and skip 8c)
 none of them (skip 8b, and continue with 8c).

8b. I thought it useful to first identify the arguments (in the case of the diagram and list) or the changes (in the case of the matrix) before starting to write the text.

- agree partly agree partly disagree disagree

Please explain your answer.....

8c. You did not work with a diagram, list or matrix. Do you think you would have preferred to work with one of those?

- yes no

Please explain your answer.....

8d. When performing a similar task in the future (writing a text on the basis of multiple sources) I will first identify important arguments.

- No, I probably will not do that; I prefer to start writing the text immediately
 I do not know for sure whether I will do that; perhaps, perhaps not
 Yes, I will certainly do that

9. Did you talk to your partner about the task, *outside* the lessons? (you can check more than one option).

- Yes, about the working of the program
 Yes, about the content of the task
 No

10. Did you spend time on this task outside the lessons? For example: did you talk about it with others, or did you search for information on the internet or in the library?

- no yes

If yes: How much time did you spend on the task outside the lessons?

- 0 – 15 minutes
 15 – 30 minutes
 30 – 45 minutes
 45 – 60 minutes
 more than 60 minutes

If yes: What did you actually do (you can check more than one option).

- consult a textbook
- consult other related books
- search for information on the internet
- talk with others about the topic of the task
- different, namely.....

Collaborative learning

11. I like to work together with someone.

- agree partly agree partly disagree disagree

12. I thought it useful to work on this task in pairs .

- agree partly agree partly disagree disagree

13. Communicating by means of the chat facility went well.

- agree partly agree partly disagree disagree

14. Working together with the diagram, list or matrix went well.

- agree partly agree partly disagree disagree

15. Writing a text together went well.

- agree partly agree partly disagree disagree

16. Which of the following aspects can be used to describe how the two of you worked together. (You can check more than one option):

- we complemented one another
- we inspired one another to new ideas
- we explained things to one another
- we drifted off too much when we were chatting
- because we did not agree we lost a lot of time
- we agreed with one another most of the time
- misunderstandings did occur regularly
- when I did not understand something, I asked my partner for explanation
- we made a clear task division
- we discussed important choices
- different:....

17. We both contributed equally to the accomplishment of this task.

- agree partly agree partly disagree disagree

18. I would have preformed better on this task, if I had worked alone.

- agree partly agree partly disagree disagree

19. Through collaborating with a fellow student I learned more about the topic of the task than I would have when working alone.

- agree partly agree partly disagree disagree

Computer use

20. How many hours per week do you spend on average at the computer in a week (at home and at school).

- less than 5 hours a week between 5 and 15 hours more than 15 hours

21. I liked using the computer for this task.

- agree partly agree partly disagree disagree

22. How did the different components of the computer program function in your opinion?

- | | | | |
|----------------------------|-------------------------------|----------------------------------|------------------------------|
| Logging in | <input type="checkbox"/> good | <input type="checkbox"/> average | <input type="checkbox"/> bad |
| Chatting | <input type="checkbox"/> good | <input type="checkbox"/> average | <input type="checkbox"/> bad |
| Representational tool | <input type="checkbox"/> good | <input type="checkbox"/> average | <input type="checkbox"/> bad |
| Text editor | <input type="checkbox"/> good | <input type="checkbox"/> average | <input type="checkbox"/> bad |
| Notes box | <input type="checkbox"/> good | <input type="checkbox"/> average | <input type="checkbox"/> bad |
| Database with source | <input type="checkbox"/> good | <input type="checkbox"/> average | <input type="checkbox"/> bad |
| Information about the task | <input type="checkbox"/> good | <input type="checkbox"/> average | <input type="checkbox"/> bad |
| The complete program | <input type="checkbox"/> good | <input type="checkbox"/> average | <input type="checkbox"/> bad |

23. Which advantages and disadvantages do you see in the use of computer-supported collaborative learning for school work?

Advantages:

Disadvantages:

24a. Did you participate in a similar project for ANW last year?

- yes no

24b. If yes, what program do you prefer? Why?

25. Do you have suggestions for improvement of the computer program?

Thanks for filling out this questionnaire!

APPENDICES

SUMMARY

Recent technological developments have provided new environments for learning, giving rise to the question of how characteristics of such new learning environments can facilitate the process of learning in specific domains. The focus of this thesis is on computer-supported collaborative learning (CSCL) in the domain of history. CSCL enables the collaborative construction of knowledge by representing learners' ideas and understandings, and by functioning as a social medium to support learning by dialogue. However, research indicates that using CSCL does not automatically lead to learning, and that it is not easy to elicit productive interaction between students. More insight is therefore needed into how characteristics of the CSCL-environment and the task are related to interaction processes and learning outcomes. Since hardly any research has been conducted on history learning and CSCL, it is important to gain insight into whether and how task-related tools in CSCL can facilitate and support historical reasoning. The general aim of the present thesis, as described in **Chapter 1**, is to investigate whether and how historical reasoning can be fostered in CSCL. In particular it is investigated how the collaborative construction of different external representations (e.g., argumentative diagram, matrix) affects students' historical reasoning in chat discussions and in collaborative text writing.

Chapter 2 describes the theoretical framework adopted in this research. Learning in history is defined, from both a disciplinary and from a learning perspective, as the active construction of an image of the past based on information from historical sources. Historical reasoning is considered a central activity of learning history. From the research literature on learning and reasoning in the domain of history, the following components of historical reasoning are identified: (1) argumentation, (2) source use, (3) historical change, (4) historical explanation, (5) contextualizing, and (6) historical concepts. From an educational point of view an important question is: How to engage students in historical reasoning? Two strategies are described in this chapter: writing and collaboration. With respect to writing, it has been argued that writing tasks, and especially the writing of an argumentative text on the basis of the study of multiple sources, can enhance historical reasoning and learning. Since historical sources often provide partial and contradictory information and viewpoints, students need to identify these differences, compare them, and make use of the context to evaluate the trustworthiness of sources. It requires them to back their claims with supportive arguments and evidence, and to provide rebuttals for possible counter-arguments. In addition, they need to use information about the characteristics of the time and place to contextualize the historical event at hand, and they need to describe and explain these changes. The use of concepts, both substantive and methodological, is an important aspect of this whole process. With respect to collaborative learning, collaboration requires students to express and verbalize their thinking to come to a shared understanding and to agreement. The quality of this interaction process is in itself an important prerequisite for learning, and interaction

processes that may contribute to learning have been characterized as elaborated, co-constructed, and domain-specific. The combination of these three features, here referred to as *co-elaborated historical reasoning*, is especially assumed to be important for learning.

Collaborating on a writing task might be useful, since writing and collaboration can be considered to be mutually supportive as they both generate verbal representations of thinking. Collaborative writing (i.e., co-authoring a text) enables students to discuss both the content and the structure of the text. The possibility of giving and receiving immediate feedback may elicit co-elaborated historical reasoning, through questioning, discussing content, explaining, and arguing. Taken together, collaborative document-based text writing may be expected to be a suitable task to engage students in historical reasoning, both in dialogue and in writing. However, research on collaborative writing has thus far focused mainly on processes of writing and argumentation, and it remains unclear whether and under which circumstances collaborative writing may contribute to reasoning and learning in history.

Computer-supported collaborative learning environments may be suitable environments to facilitate historical reasoning in dialogue and in collaborative writing, for they can offer communicative and task-related support. Moreover, they offer the potential of integrating reading activities, writing activities and collaborative discussions in one single environment. Nonetheless, research indicates that using CSCL does not automatically lead to learning, and that it is not easy to elicit productive interaction between students. Therefore, more research is needed to investigate the complex relation between tools in the CSCL-environment, the task, interaction processes and learning outcomes. It is unclear whether and how task-related tools in CSCL can facilitate and support historical reasoning. This research focuses particularly on tools for the construction of external representations (e.g., concept map, argumentative diagram, matrix). From a socio-constructive perspective, it is assumed that the collaborative construction of external representations by students contributes to learning. The collaborative construction of an external representation during the planning phase of a writing task can be hypothesized to facilitate not only co-elaborated historical reasoning in on-line dialogues, but also to offer support for collaborative text writing. This hypothesis will be investigated in the present study. Moreover, as it is assumed that the representational format may influence interaction processes, different representations will be compared in this study. Hence, the research question central to this thesis can be formulated as follows: *How does the collaborative construction of different external representations in CSCL affect historical reasoning in dialogue and collaborative text writing?*

Chapter 3 provides an overview of the methods used to investigate the central research question. In order to answer the main question, the following three research questions were investigated:

1. Is a collaborative writing task in CSCL a suitable task to engage students in historical reasoning?

2. What are the effects of the type of historical inquiry question (explanatory and evaluative) on collaborative historical reasoning in chat discussions and text writing, and on individual learning outcomes?
3. How does the collaborative construction of different external representations affect:
 - a. historical reasoning in chat discussions
 - b. historical reasoning in text writing
 - c. individual learning outcomes?

To investigate these questions two experimental studies were conducted, including a pretest/post-test measurement. The first two questions, which are more preliminary, were investigated in the first study and reported in Chapter 4. In this study, two types of inquiry questions were compared, namely an explanatory question and an evaluative question. The main emphasis of this thesis is however on the third question, which is investigated in the second study. In this study the effects of three different representations were compared with a control condition (no representational tool). This study was carried out within two school years. In the first year, two representational tools were compared: an argumentative diagram and an argument list. In the second year, two conditions were added: the matrix and the control condition. Chapter 5 reports on the comparison between the Diagram and the List and Chapter 6 reports on the comparison between the Diagram, the List, the Matrix and the Control condition (thus data of the Diagram and List conditions were used for the studies described in Chapter 5 and in Chapter 6).

Subjects of both studies were 16 and 17 year old students from history classes in pre-university education. The students worked for 6 lessons (50 minutes each) in randomly assigned pairs on a historical inquiry task in CSCL. This task involved the study of several historical sources and the writing of a text (1.000 words). The task was about the changes in the behavior of the Dutch youths in the 1960's. In the first study the CSCL-environment TC3 was used, and in the second study VCRI. The environments comprised a chat-facility, a shared text-editor, information sources, and a private notepad. Each student worked on his or her own computer, physically separated from his or her partner.

The analyses focused both on the learning process and the learning outcomes, and included the chat dialogues, the quality of the collaboratively written texts, and individual learning outcomes as measured by the pretest and post-test. Additionally, in the second study the analyses also included the quality of the constructed representations of the different conditions. Chat dialogues were analyzed on the level of task acts, which refer to the function of the utterance in relation to the execution of the task. Chat utterances coded as historical reasoning were then further analyzed from three perspectives: type of historical reasoning (i.e., time, description, change, explanation, standpoint or source use), type of elaboration (i.e., an elaborative reasoning episode starting with a question, with a statement or with a conflict), and degree of co-construction (i.e., individual reasoning episode, reasoning episode in which one student dominates, or reasoning episode to which both students equally contribute).

Finally, historical reasoning episodes were discerned that were both elaborated and co-constructed, since it was assumed that especially these episodes would contribute to the learning process. These episodes are referred to with the term *co-elaborated historical reasoning*. The representations constructed in the second study were analyzed on the number of arguments for and against, the balance of arguments for and against, and the number of sources referred to. The collaboratively written texts were analyzed using the different components of historical reasoning, which were described in Chapter 2. The pretest and post-test was administered to indicate individual learning about the topic at hand. The interrater reliability for the analyses of the chat, the texts, and the tests turned out to be satisfactory. In order to test differences between the conditions, both univariate and multivariate analyses of variance were carried out.

Chapter 4⁵ reports the results of the first study. The first two research questions were addressed in this study: (1) Is a collaborative writing task in CSCL a suitable task to engage students in historical reasoning? and (2) What are the effects of the type of historical inquiry question on collaborative historical reasoning in chat discussions and text writing, and on individual learning outcomes? Two inquiry questions were compared: an evaluative question ('Were the changes in the behavior of the Dutch youths in the 1960's revolutionary?') and an explanatory question ('How can the changes in the behavior of the Dutch youths in the 1960's be explained?'). Ten pairs of students participated in this study, five pairs in each of the two conditions.

From this study two conclusions were drawn. Firstly, a collaborative writing task in CSCL can foster historical reasoning in chat dialogues and in writing. The chat protocols and the texts reflected the different components of historical reasoning, and all students improved their performances on the post-test. However, the amount and quality of historical reasoning both in dialogues and in the texts could still be improved, in particular with respect to the use of supporting arguments and the rebuttal of contra arguments, the evaluation of source, and the use of concepts. Secondly, the results indicated that different inquiry questions in a collaborative writing task can elicit differences in students' reasoning and learning, and that especially an evaluative question has the potential to elicit historical reasoning. The evaluative question resulted in significantly more historical reasoning episodes, more elaboration, more co-construction, and texts of higher quality (however no differences were found for the post-test). Although this was only a small-scale study, the differences found between the two inquiry questions are in line with other research findings. It can be suggested that an evaluative task has more potential to elicit historical reasoning in the chat, because it is a task in which several (conflicting) viewpoints exist, which makes it more open for discussion and argumentation, and because it requires more personal involvement. Moreover, writing a text addressing an evaluative

⁵ Van Drie, J., Van Boxtel, C., & Van der Linden, J. (2006). Historical reasoning in a computer-supported collaborative learning environment. In A. M. O'Donnell, C. E. Hmelo, & G. Erkens (Eds.), *Collaborative learning, reasoning, and technology* (pp. 265-296). Mahwah, NJ: Lawrence Erlbaum.

question seems to include more components of historical reasoning (among which point of view, changes, explaining, and sources) than the writing of a text addressing an explanatory question.

The aim of the study that is reported in **Chapter 5**⁶ was to promote historical reasoning in CSCL by using external representational tools. In this study, the joint construction of a graphical representation (argumentative diagram) and of a linear representation (argument list) was compared. Because of its graphical structure, it was assumed that an argumentative diagram would be a more powerful tool to promote historical reasoning, both in the chat discussion as well as in the text. Sixty students participated in this study, of which 16 student-pairs in the Diagram condition, and 14 student-pairs in the List condition. The results suggested that the List is more suitable to represent a large amount of information, whereas the Diagram focuses more on the organization of the arguments. However, these differences did not result in significant differences in the amount of historical reasoning, the amount of co-elaborated historical reasoning, the quality of the text, and in the scores on the post-test. A possible explanation for these outcomes might be that the students did not have much experience in using a representation for text writing, which might have been especially disadvantageous in the Diagram condition. Compared to the Diagram, the linear structure of the List was more familiar to students, and may have been easier to use for text writing.

The aim of the study reported in **Chapter 6**⁷, was to investigate the effects of the joint construction of different external representations in CSCL on historical reasoning in chat and writing, and the individual learning outcomes. Since it is assumed that the representational format used may influence the collaborative process and its' outcomes, three representational formats (an argumentative diagram, an argument list and a matrix) were compared to a control group in which no representational tool was available. In this study, 130 students from pre-university education collaborated on a historical writing task in a CSCL environment (16 student-pairs in the Diagram condition, 14 in the List condition, 17 in the Matrix condition, and 18 student-pairs in the Control condition). The analyses included analyses of interaction processes in the chat, the quality of the constructed representation, the quality of the text, and the scores on the individual pretest and post-test.

The results both supported and contradicted our hypotheses. The assumption that the joint construction of a representation would result in more historical reasoning in the chat protocols and in the written texts, compared to the control condition, was not confirmed. The Control condition scored as well as the experimental conditions on text quality and the post-test, and even better on co-elaborated historical reasoning in the chat. A possible explanation for this latter outcome can be found in the way

⁶ Van Drie, J., Van Boxtel, C., Erkens, G., & Kanselaar, G. (2005). Using representational tools to support historical reasoning in computer-supported collaborative learning. *Technology, Pedagogy and Education*, 14(1), 25-42.

⁷ Van Drie, J., Van Boxtel, C., Jaspers, J., & Kanselaar, G. (2005). Effects of representational guidance on domain specific reasoning in CSCL. *Computers in Human Behavior*, 21(4), 575-602.

the students made use of the representational tool while executing the task. The tool did not only function as a cognitive tool that can elicit elaborate activities, but also as a tool *through which* students communicate. This may have resulted in less co-elaborated historical reasoning in the chat for the experimental conditions compared to the Control condition. The hypothesis that the representational format used would affect students' reasoning in the chat dialogues was supported by this study. The results indicated that each representational format had its own affordances and constraints. The Diagram and the List directed students' attention more to the arguments for and against, while the Matrix directed students to the different historical changes as well. Especially the Matrix seems to have potential to support domain-specific reasoning, since the chat dialogues in this condition showed (in comparison to the Diagram and List) more co-elaborated historical reasoning, and more reasoning about historical changes. The structure of the Matrix seems to have prompted students to fill in all available historical changes, label their revolutionary impact, and to use all the available information sources. Just as the Matrix, the List is also suitable to represent much information. However, the List is less structured, and did not elicit much historical reasoning. The Diagram, on the other hand, seems to be less suitable for representing much information, because its structure then becomes too complex. Still, when using the Diagram the students reached more balance between number of arguments for and against, since this aspect is directly visible. These differences did not result in significant differences between the conditions on either the post-test or the quality of the text. The latter might be related to the fact that (1) in the Control condition students could spend more time on writing the text, since they did not have to construct a representation, and (2) students in general had little experience with using external representations for text writing.

In sum, from this study it was concluded that (1) the representational format used shapes the process of historical reasoning in the chat dialogues, (2) the representational tool does not only function as a cognitive tool that can elicit elaborative activities, but also as a tool through which students communicate and elaborate, (3) each representational format has its' own affordances and constraints, and (4) especially the matrix has the capacity to enhance co-elaborated historical reasoning.

Chapter 7 describes the main outcomes of the studies, discusses limitations, provides suggestions for further research, and draws some practical implications. Overall, the research has revealed that CSCL can indeed foster historical reasoning by means of on-line dialogues and the construction of shared products such as texts and external representations. Furthermore, it has shown that the process of historical reasoning is in part shaped by the inquiry question posed, and by the format of the representations involved. However, the role of the chat discussions did turn out to be somewhat different than expected at the start of this research. First, coordination and management of the task figured more prominently in chat discussions than initially expected, which can be related to the complexity of the task. Second, as the control condition showed more co-elaborated historical reasoning in the chat, the initial hypothesis that the joint construction of an external representation

would elicit more historical reasoning in the chat was not confirmed. Subsequent analysis of the diversity of topics mentioned in chats and representations, suggested a different conceptualization of their interrelations than initially adopted. Though in the experimental conditions the range of topics discussed in chats alone was less diverse, relative to the control condition, a combined analysis of both chat and representation showed that in sum, the range of topics in the experimental conditions was significantly more diverse than in the control conditions. It would therefore appear that when a representational tool is used, the process of historical reasoning takes place not only in chat discussions, but also within and through the construction of the representation itself. Representing information in an external representation and communicating it through chat may well seem like doing things twice in the eyes of students, in the sense that its inclusion in the representation makes this information already part of the shared context, which results in less discussion in the chat. Although analyzing both learning processes and learning outcomes seems a fruitful approach, these findings suggest that it might be more appropriate to view chat discussions and representational constructions as elements of one and the same process, rather than as separate items as we did in our initial analyses. We therefore suggest that a more holistic approach, including the construction process as an element of one and the same collaborative process, rather than as distinct from chat discussions, should be the focus of future research. Our findings then also quite clearly point to a specific advantage provided by the inclusion of representations, namely a broader range of topics represented.

When considering the findings of this study, several limitations should be taken into account. This study shows that a complex interplay between characteristics of the task, the CSCL-environment, interaction processes, and learning outcomes exists, and that it is not easy to unravel how these aspects influence each other. Our findings could have been influenced by other factors, such as students' experience with CSCL, their skills at writing in history and collaborating, their experience with the use of external representations for text writing, and the influence of the year-group. In addition, the task involved many different aspects, and the differences between the conditions may have been too small to yield large effects, especially on a strict measure as co-elaborated historical reasoning. In generalizing the present findings it has to be taken into account that this study was conducted within one domain, with one task, one student level, and one CSCL-environment. Although the outcomes of this study give some insight into the mediating role of external representations in a writing task in history, caution is warranted in extending results to other domains, other learning tasks, and other CSCL-environments (including other forms of communications than chatting). In addition, the choice of representational tools was closely related to the topic of the task, and other representational formats may be useful within other tasks and other topics (for example a causal diagram when using an explanatory question).

Future research should focus on (1) the supporting role of representations in CSCL in relation to domain-specific reasoning and learning (e.g., What is the influence of other representational formats in supporting other components of historical reasoning, and in relation to other tasks than text writing?)

SUMMARY

What are characteristics of representational tools to support reasoning and learning in other domains, such as geography and economics? How do students actually make use of the constructed representation for text writing?), (2) characteristics of tasks that can elicit historical reasoning in CSCL, (3) the influence of characteristics of tasks and tools on the interaction process and learning outcomes, and (4) the role of experience with CSCL on the learning process and outcomes.

From a more practical point of view, it can be argued that CSCL-environments are especially useful in the context of active and self-directed learning, and a collaborative writing task based on studying multiple sources, and requiring evaluation, clearly does appear to be one way to successfully elicit historical reasoning in CSCL. Furthermore, the process of historical reasoning can to some extent be supported by the collaborative construction of external representations.

In conclusion, we return to our main question of the facilitating role of CSCL to foster historical reasoning. Considering the limitations of this study described above, it can be concluded that CSCL is useful in fostering historical reasoning, as it can offer both task-related and communicative support.

Within such an environment, a collaborative writing task, involving the study of multiple sources and addressing an evaluative question, has been shown to be especially suited to elicit historical reasoning.

The reasoning processes so elicited take place not only within the communication tool used (in this case the chat box), but also within the joint construction of products. The characteristics of the representational tools used, play an important role in shaping the historical reasoning processes elicited. To summarize, the process of historical reasoning in CSCL is mediated by the question addressed, the representational tools applied, and the type of products asked for and constructed.

SAMENVATTING

Recente technologische ontwikkelingen bieden allerlei mogelijkheden om nieuwe leeromgevingen te ontwerpen. Een belangrijke vraag hierbij is hoe kenmerken van deze nieuwe leeromgevingen het leerproces in verschillende domeinen kan ondersteunen. Dit proefschrift richt zich op computerondersteund samenwerkend leren (computer-supported collaborative learning, afgekort CSCL) in het domein geschiedenis. In een CSCL-omgeving kunnen leerlingen ideeën en inzichten uitwisselen en samen kennis opbouwen. Echter, uit onderzoek blijkt dat het gebruik van een CSCL-omgeving niet vanzelfsprekend leidt tot leren en dat het niet eenvoudig is om productieve interactie tussen leerlingen te ontlokken. Er is daarom meer inzicht nodig in hoe kenmerken van de CSCL-omgeving en de taak, interactieprocessen en leeruitkomsten beïnvloeden. Omdat er nog nauwelijks onderzoek is verricht naar geschiedenis leren in een CSCL-omgeving, is het daarnaast van belang om meer inzicht te krijgen in de wijze waarop taakgerelateerde tools (hulpmiddelen in de elektronische leeromgeving) in CSCL, historisch redeneren kunnen ontlokken en ondersteunen. Het algemene doel van dit proefschrift, zoals beschreven in **Hoofdstuk 1**, is dan ook te onderzoeken hoe historisch redeneren in CSCL bevorderd kan worden. Het onderzoek richt zich specifiek op wat de invloed is van het type externe representatie dat samen gemaakt wordt (bijvoorbeeld een argumentatief diagram of een matrix), op historisch redeneren in de chat-discussies en in het samen schrijven van een tekst.

Hoofdstuk 2 beschrijft het theoretisch kader dat aan dit onderzoek ten grondslag ligt. Zowel vanuit het perspectief van geschiedenis als discipline, als vanuit een leertheoretisch perspectief wordt geschiedenis leren omschreven als de actieve constructie van kennis van het verleden, op basis van informatie uit historische bronnen. Historisch redeneren wordt gezien als een centrale activiteit binnen geschiedenis leren. Op basis van de onderzoeksliteratuur naar leren en redeneren bij geschiedenis worden de volgende componenten van historisch redeneren onderscheiden: (1) argumenteren, (2) gebruik van bronnen, (3) beschrijven van historische veranderingen, (4) geven van historische verklaringen, (5) contextualiseren, en (6) gebruik van historische begrippen.

Een belangrijke vraag is hoe leerlingen aangezet kunnen worden tot historisch redeneren. In dit hoofdstuk worden twee strategieën beschreven: schrijven en samenwerken. Over schrijven wordt beweerd dat schrijftaken, en met name het schrijven van argumentatieve teksten op basis van verschillende bronnen, historisch redeneren en leren kunnen ontlokken. Omdat historische bronnen vaak incomplete informatie en tegenstrijdige interpretaties bevatten, is het nodig dat leerlingen deze verschillen identificeren, ze vergelijken en daarbij gebruik maken van de context van de bron om de betrouwbaarheid te beoordelen. Het zet aan tot het onderbouwen van hun beweringen met ondersteunende argumenten en bewijzen, en tot het weerleggen van mogelijke tegenargumenten. Verder vraagt het van hen dat ze informatie over de tijd en de plaats gebruiken om het historische

verschijnsel in context te plaatsen, en dat ze veranderingen beschrijven en verklaren. Het gebruik van zowel inhoudelijke als methodologische begrippen is een belangrijk aspect van dit hele proces. Samenwerking vereist van leerlingen dat zij hun denken uiten en onder woorden brengen om te komen tot gedeeld begrip en tot overeenstemming. De kwaliteit van dit interactieproces als zodanig is een belangrijke factor voor leren in samenwerking. Belangrijke kenmerken van interactieprocessen die bijdragen aan leren zijn elaboratie (diepere verwerking), co-constructie van redeneringen en redeneren dat kenmerkend is voor het betreffende domein. De veronderstelling is dat voor het leren van geschiedenis interactieprocessen die gekenmerkt worden door een combinatie van deze drie aspecten productief is, hier aangeduid met de term *co-elaboratief historisch redeneren*. Verder wordt verondersteld dat samenwerken aan een schrijftaak zinvol kan zijn. Schrijven en samenwerken kunnen gezien worden als wederzijds ondersteunende activiteiten, aangezien ze beide verbale representaties van denken genereren. Samen schrijven (d.w.z. samen auteur zijn van één tekst) biedt leerlingen de gelegenheid om te discussiëren over zowel de inhoud als de structuur van de tekst. Het geven en ontvangen van directe feedback tijdens het schrijfproces kan co-elaboratie ontlokken, door middel van activiteiten als het stellen en beantwoorden van vragen, het bediscussiëren van de inhoud, het geven van verklaringen, en argumenteren. De verwachting is dan ook dat het samen schrijven van een argumentatieve tekst op basis van bronnen, een geschikte taak is zijn om leerlingen aan te zetten tot historisch redeneren, zowel in dialoog als in schrijven. Echter, onderzoek naar samen schrijven heeft zich, totnogtoe, met name gericht op het schrijf- en argumentatie proces en het blijft nog onduidelijk of en onder welke omstandigheden samen schrijven kan bijdragen aan leren en redeneren bij geschiedenis.

Een CSCL-omgeving kan een geschikte leeromgeving zijn om historisch redeneren in dialoog en schrijven te faciliteren, aangezien deze leeromgevingen zowel communicatieve ondersteuning kunnen bieden als taakgerelateerde ondersteuning. Daarnaast bieden zij de mogelijkheid om leesactiviteiten, schrijfactiviteiten en discussies in één leeromgeving te integreren. Verschillende onderzoeken hebben echter aangetoond dat het gebruik van CSCL-omgevingen niet vanzelfsprekend leidt tot leren en dat het niet eenvoudig is om hierbij productieve interactie tussen leerlingen te ontlokken. Het is dan ook onduidelijk of en hoe taakgerelateerde tools in CSCL historisch redeneren zouden kunnen ontlokken en ondersteunen. Dit onderzoek richt zich specifiek op tools voor het maken van externe representaties (bijvoorbeeld een begrippenschema, een argumentatief diagram, een matrix). Vanuit een socio-constructivistisch perspectief op leren wordt aangenomen dat het samen maken van een externe representatie door leerlingen positief bijdraagt aan het leerproces. Verondersteld kan worden dat het samen maken van een externe representatie tijdens de planningsfase van het schrijfproces, zowel co-elaboratief historisch redeneren in on-line dialogen faciliteert, als ondersteuning biedt voor het samen schrijven van een tekst. In dit proefschrift wordt deze veronderstelling onderzocht. Aangezien, in aanvulling hierop, aangenomen wordt dat de vorm van de representatie van invloed is op het interactieproces, worden in dit proefschrift verschillende tools voor het maken van externe

representaties met elkaar vergeleken. De algemene onderzoeksvraag van dit proefschrift is als volgt geformuleerd: *Wat is de invloed van het type externe representatie dat samen gemaakt wordt in CSCL op het historisch redeneren in de chat en het samen schrijven van een tekst?*

Hoofdstuk 3 geeft een overzicht van de gebruikte onderzoeksmethode. Om de hoofdvraag van dit onderzoek te beantwoorden zijn er drie deelvragen geformuleerd:

1. Is een samen schrijftaak in CSCL een geschikte taak om historisch redeneren te ontlokken?
2. Wat zijn de effecten van het type vraagstelling (verklarend of evaluatief) op het samen historisch redeneren in chat-discussies, het samen schrijven van een tekst en op de individuele leeruitkomsten?
3. Wat zijn de effecten van het type representatie dat samen geconstrueerd wordt op:
 - a. historisch redeneren in chat-discussies,
 - b. historisch redeneren in de geschreven teksten,
 - c. individuele leerresultaten?

Om deze vragen te onderzoeken zijn er twee experimentele studies uitgevoerd, beide met een voor- en nameting. In de eerste studie (beschreven in hoofdstuk 4) worden de eerste twee meer onderliggende vragen onderzocht en wordt de invloed van twee type vraagstellingen voor historisch onderzoek vergeleken, namelijk een verklarende vraag en een evaluatieve vraag. De meeste nadruk ligt in dit proefschrift echter op de derde onderzoeksvraag, die in de tweede studie onderzocht is. In deze studie wordt het effect van drie verschillende externe representaties met elkaar en met een controle groep vergeleken. Deze studie is uitgevoerd in twee schooljaren. In het eerste jaar zijn twee representatievormen met elkaar vergeleken: het diagram en de lijst. In het tweede jaar is het onderzoek uitgevoerd voor de matrix en de controle conditie. Hoofdstuk 5 rapporteert over de uitkomsten van de vergelijking tussen diagram en lijst en hoofdstuk 6 over de vergelijking tussen diagram, lijst, matrix en controle groep. Dus de gegevens van het diagram en de lijst zijn gebruikt voor zowel de studie in hoofdstuk 5, als de studie in hoofdstuk 6.

Leerlingen geschiedenis uit 5 VWO (16, 17 jaar oud) namen deel aan beide studies. De leerlingen werkten gedurende 6 lessen (van elk 50 minuten) in willekeurig samengestelde tweetallen aan een onderzoekstaak in een CSCL-omgeving. De onderzoeksopdracht hield in dat de leerlingen verschillende historische bronnen moesten bestuderen over de veranderingen in het gedrag van de (Nederlandse) jeugd in de jaren zestig en hierover samen een essay moesten schrijven van ongeveer 1.000 woorden. In de eerste studie werkten leerlingen in de CSCL-omgeving TC3 en in de tweede studie in VCRI, beide ontwikkeld binnen de onderzoeksgroep van Onderwijskunde van de Universiteit Utrecht. Beide leeromgevingen bestaan uit een chat-box, een gemeenschappelijke tekstverwerker, informatiebronnen en een individueel scherm voor het maken van aantekeningen. Iedere leerling werkt achter een eigen computer en in een ander lokaal dan de partner.

De analyses richten zich op het interactieproces (chat-gesprekken) en de leeruitkomsten (de kwaliteit van de gezamenlijk geschreven teksten en de individuele leerresultaten zoals gemeten door de natoets). In de tweede studie zijn daarnaast ook de geconstrueerde representaties (diagram, matrix en lijst) geanalyseerd. De chat-protocollen zijn eerst geanalyseerd op het niveau van taakhandelingen, dat wil zeggen de functie van de uitspraak in relatie tot de uitvoering van de taak. Uitspraken die gecodeerd zijn als historisch redeneren, zijn vervolgens verder geanalyseerd vanuit drie perspectieven: type historisch redeneren (tijd, beschrijving, verandering, verklaring, standpunt of brongebruik), type elaboratie (een uitgebreide redeneerperiode startend met een vraag, met een bewering of met een conflict) en de mate van co-constructie (individuele redenering, een leerling domineert de redenering, beide leerlingen dragen in gelijke mate bij aan de redenering). Ten slotte werden episodes van historisch redeneren geïdentificeerd die zowel elaboratief zijn (co-elaboratief historisch redeneren), als geconstrueerd door beide leerlingen, omdat met name van dit type redeneringen verwacht wordt dat ze bijdragen aan het leerproces. De geconstrueerde representaties uit de tweede studie zijn geanalyseerd op het aantal argumenten voor en tegen, de balans tussen de argumenten voor en tegen en het aantal bronnen waaraan gerefereerd werd. De gezamenlijk geschreven teksten zijn geanalyseerd door gebruik te maken van de componenten van historisch redeneren die in het theoretisch kader (hoofdstuk 2) onderscheiden zijn. De voor- en natoets is afgenomen om inzicht te krijgen in hoeverre leerlingen op individueel niveau geleerd hebben over het onderwerp van de opdracht. De interbeoordelaarsbetrouwbaarheid voor de analyses van de chats, teksten en toetsen bleek voldoende te zijn. Om verschillen tussen de condities te bepalen is gebruik gemaakt van univariate en multivariate variantie analyses.

Hoofdstuk 4⁸ beschrijft de resultaten van de eerste studie, waarin de eerste twee deelvragen central staan: (1) Is een samen schrijftaak in CSCL een geschikte taak om historisch redeneren te ontlokken? (2) Wat zijn de effecten van het type vraagstelling (verklarend of evaluatief) op het samen historisch redeneren in chat-discussies, op het samen schrijven van een tekst en op de individuele leeruitkomsten? Twee type vraagstellingen werden vergeleken: een evaluatieve vraag ('Waren de jaren zestig revolutionair als je kijkt naar veranderingen in het gedrag van de jeugd?') en een verklarende vraag ('Hoe kunnen de veranderingen in het gedrag van de jeugd in de jaren zestig verklaard worden?'). Aan deze studie namen 20 leerlingen deel, 5 tweetallen in elke conditie.

De uitkomsten van deze studie geven aanleiding tot de volgende twee conclusies. Ten eerste, een samen schrijftaak in CSCL kan historisch redeneren ontlokken, zowel in de chat als in het schrijven van de tekst. De verschillende componenten van historisch redeneren waren zichtbaar in de chat-protocollen en in de geschreven teksten en de leerlingen scoorden significant beter op de natoets. De

⁸ Van Drie, J., Van Boxtel, C., & Van der Linden, J. (2006). Historical reasoning in a computer-supported collaborative learning environment. In A. M. O'Donnell, C. E. Hmelo, & G. Erkens (Eds.), *Collaborative learning, reasoning, and technology* (pp. 265-296). Mahwah, NJ: Lawrence Erlbaum.

hoeveelheid en kwaliteit van historisch redeneren bleek, zowel in de chat als in de teksten, minder sterk te zijn ten aanzien van het gebruik van ondersteunende argumenten, het ontkrachten van tegenargumenten, de beoordeling van bronnen en het gebruik van historische begrippen. Ten tweede blijkt uit deze studie dat verschillende typen vraagstellingen in een samen schrijftaak, resulteren in verschillen in redeneren en leren en dat de evaluatieve vraag, in vergelijking tot de verklarende vraag, een krachtiger type vraagstelling is om historisch redeneren te ontlokken. Het beantwoorden van de evaluatieve vraag resulteerde in significant meer historisch redeneren, meer elaboratie en meer co-constructie in de chat en in teksten van hogere kwaliteit (er werden geen verschillen gevonden op de natoets). Er dient bij de interpretatie van deze resultaten wel rekening gehouden te worden met het feit dat relatief weinig leerlingen aan deze studie deelnamen. De gevonden resultaten overeen met resultaten uit ander onderzoek. Een evaluatieve vraag blijkt een krachtiger vraagstelling te zijn om historisch redeneren te ontlokken, omdat het een taak is waarbij verschillende (conflicterende) interpretaties bestaan, waardoor discussie en argumentatie ontlokt kunnen worden en omdat evaluatie meer persoonlijke betrokkenheid vraagt. Daarnaast blijkt dat het schrijven van een tekst op basis van een evaluatieve vraag het gebruik van meer componenten van historisch redeneren impliceert (waaronder argumentatie, verandering, verklaring en brongebruik) in vergelijking met het schrijven van een tekst op basis van een verklarende vraag.

In de studie die beschreven wordt in **Hoofdstuk 5**⁹, is onderzocht of historisch redeneren in CSCL bevorderd kan worden door tools (hulpmiddelen in de elektronische leeromgeving) voor het maken van een externe representatie. De effecten van het samen maken van een grafische representatie (argumentatief diagram) en een meer lineaire representatie (argumenten lijst) zijn in deze studie met elkaar vergeleken. De verwachting was dat een argumentatief diagram, vanwege de grafische structuur, een krachtiger tool zou zijn om historisch redeneren te ondersteunen, zowel in de chat als in het tekstschrijven. Aan dit experiment namen 60 leerlingen deel, waarvan 16 paren participeerden in de diagram conditie en 14 paren in de lijst conditie. De resultaten suggereren dat de lijst meer geschikt is om grotere hoeveelheden informatie weer te geven, terwijl een diagram de aandacht meer laat richten op de organisatie van de argumenten. Echter, deze verschillen leidden niet tot significante verschillen ten aanzien van de hoeveelheid en het type historisch redeneren, de hoeveelheid co-elaboratief historisch redeneren, de kwaliteit van de teksten en de uitkomsten op de natoets. Een mogelijke verklaring hiervoor ligt in het feit dat de leerlingen weinig ervaring hadden met het maken van representaties in een schrijftaak, wat met name nadelig zou kunnen zijn voor de diagram conditie. In vergelijking tot het diagram, is de lineaire structuur van de lijst meer bekend voor de leerlingen en wellicht daardoor ook makkelijker te gebruiken bij het schrijven van een tekst.

⁹ Van Drie, J., Van Boxtel, C., Erkens, G., & Kanselaar, G. (2005). Using representational tools to support historical reasoning in computer-supported collaborative learning. *Technology, Pedagogy and Education*, 14(1), 25-42.

Het doel van de studie beschreven in **Hoofdstuk 6**¹⁰, was verder te onderzoeken wat de effecten zijn van het samen maken van verschillende externe representaties in CSCL op het samen historisch redeneren in de chat, het samen schrijven van een tekst en op de individuele leeruitkomsten. Omdat verondersteld kan worden dat de vorm van de gebruikte representatie het samenwerkingsproces en de leeruitkomsten beïnvloedt, zijn in deze studie drie tools voor het maken van representatievormen (diagram, lijst en matrix) met elkaar en met een controle groep (geen representatie tool) vergeleken. Aan deze studie namen in totaal 130 leerlingen uit 5 VWO deel; 16 paren in de diagram conditie, 14 in de lijst conditie, 17 in de matrix conditie en 18 paren in de controle conditie. De analyses richtten zich op het interactieproces in de chat, de kwaliteit van de geconstrueerde representatie, de kwaliteit van de tekst en op de scores op de individuele natoets.

Onze verwachtingen werden door de resultaten zowel ondersteund als tegengesproken. De verwachting dat het samen maken van een representatie zou leiden tot meer historisch redeneren in de chat en bij het schrijven van de tekst, werd niet ondersteund door de resultaten. De controle groep scoorde net zo goed als de andere condities op tekstkwaliteit en op de natoets en zelfs beter op de hoeveelheid co-elaboratief historisch redeneren in de chat. Een mogelijke verklaring voor deze laatste uitkomst is te vinden in de wijze waarop de leerlingen gebruik maakten van de representatie-tool tijdens de uitvoering van de opdracht. De tool bleek niet alleen te functioneren als een cognitieve tool die elaboratieve activiteiten ontlokt, maar ook als een tool *waardoor* leerlingen communiceren. Dit kan tot minder co-elaboratief historisch redeneren in de chat bij de experimentele condities geleid hebben. De hypothese dat de vorm van de representatie invloed heeft op het redeneren in de chat werd wel door de resultaten ondersteund. De resultaten laten duidelijk zien dat elke representatievorm zijn eigen voor- en nadelen heeft. De diagram en de lijst richtten de aandacht van de leerlingen met name op het argumentatieproces, terwijl de matrix de aandacht ook richtte op de verschillende historische veranderingen. Met name de matrix blijkt een krachtige representatievorm te zijn om historisch redeneren te ondersteunen; de chats in deze conditie bevatten (in vergelijking tot het diagram en de lijst) meer co-elaboratief historisch redeneren en meer redeneren over historische veranderingen. De structuur van de matrix lijkt leerlingen er toe aan te zetten om alle historische veranderingen in te vullen, te beoordelen in hoeverre elke verandering revolutionair is, en om informatie uit alle beschikbare bronnen te gebruiken. De lijst is, net als de matrix, geschikt om veel informatie weer te geven. Maar de lijst is minder gestructureerd dan de matrix en de constructie ervan ontlokte niet veel historisch redeneren in de chat. Het diagram daarentegen lijkt minder geschikt om veel informatie weer te geven, omdat de structuur dan snel te complex en onoverzichtelijk wordt. Een voordeel van het diagram is echter wel dat er een betere balans is tussen de argumenten voor en tegen, omdat dit

¹⁰ Van Drie, J., Van Boxtel, C., Jaspers, J., & Kanselaar, G. (2005). Effects of representational guidance on domain specific reasoning in CSCL. *Computers in Human Behavior*, 21(4), 575-602.

direct zichtbaar is in de structuur. Bovengenoemde verschillen hebben echter niet geleid tot significante verschillen tussen de condities ten aanzien van de natoets scores en de kwaliteit van de teksten. Dit laatste kan te maken hebben met het feit dat (1) leerlingen in de controle groep meer tijd konden besteden aan het schrijven van de tekst omdat ze geen representatie hoefden te maken, en (2) de leerlingen weinig ervaring hadden met het gebruik van externe representaties voor het schrijven van een tekst.

De conclusies uit deze studie kunnen als volgt samengevat worden: (1) de gebruikte representatievorm heeft invloed op het proces van historisch redeneren in de chat, (2) de representatie-tool functioneert niet alleen als een cognitieve tool die elaboratie ontlokt, maar ook als een tool waardoor leerlingen communiceren en elaboreren, (3) elke representatievorm heeft zijn eigen voor- en nadelen en (4) met name de matrix lijkt een krachtige vorm te zijn om co-elaboratief historisch redeneren te ontlocken.

In **Hoofdstuk 7** worden de belangrijkste uitkomsten van dit onderzoek beschreven, de beperkingen van dit onderzoek bediscussieerd, suggesties voor vervolgonderzoek gegeven en enkele praktische implicaties voor het onderwijs besproken. Al met al toont dit onderzoek aan dat computerondersteund samenwerkend leren inderdaad historisch redeneren kan bevorderen, zowel in dialoog als in de gezamenlijke constructie van producten, zoals externe representaties en teksten. Daarnaast toont dit onderzoek aan dat het proces van historisch redeneren ten dele beïnvloed wordt door het type vraagstelling, en door de vorm van de gebruikte externe representaties. De rol van de chat-discussies bleek echter toch wat anders te zijn dan aanvankelijk werd aangenomen. Ten eerste bleek het coördineren en reguleren van de taak prominenter aanwezig in de chat dan vooraf verwacht werd, wat waarschijnlijk verband houdt met de complexiteit van de opdracht. Ten tweede werd de hypothese dat de gezamenlijke constructie van een externe representatie meer historisch redeneren ontlokt niet bevestigd, aangezien in de controle groep meer co-elaboratief historisch redeneren in de chats werd gevonden. Een aanvullende analyse van het aantal verschillende onderwerpen (topics) die in de chat en in de representaties genoemd werden, suggereerde echter een andere conceptualisering van de samenhang dan in eerste instantie was toegepast. Uitgaande van alleen de chats bleek dat in de controle conditie de variatie in besproken topics groter was dan in de experimentele condities. Een analyse van de topics genoemd in de chats in combinatie met die genoemd in de representaties, wees echter uit dat opgeteld de variatie aan besproken topics in de experimentele condities groter was dan in de controle conditie. Geconcludeerd kan worden dat wanneer er een representatie-tool gebruikt wordt, het redeneerproces niet alleen plaatsvindt in de chat, maar ook in en door het maken van de representatie als zodanig. Het weergeven van informatie in de representatie en het communiceren over die informatie in de chat zou door leerlingen zeer wel gezien kunnen worden als dubbel werk, in de zin dat door het opnemen van informatie in de representatie deze reeds onderdeel uitmaakt van de gedeelde context, waardoor er minder over deze informatie gecommuniceerd wordt in de chat. Deze uitkomsten wekken de suggestie dat het beter zou zijn om chat-discussies en het construeren van

representaties te zien als elementen van één en hetzelfde proces, in plaats van als aparte elementen zoals in de analyses die hier in eerste instantie gebruikt werden. Toekomstig onderzoek zou dan ook uit moeten gaan van een meer holistische benadering, waarin het constructieproces en de chat-gesprekken gezien worden als elementen van één en hetzelfde samenwerkingsproces. Verder blijkt uit deze aanvullende analyse een duidelijk voordeel van het gebruik van externe representaties: het leidt tot het representeren van een grotere variatie aan onderwerpen.

Bij de interpretatie van de uitkomsten van dit onderzoek dient rekening gehouden te worden met een aantal beperkingen van deze studie. Dit onderzoek laat zien dat kenmerken van de taak, van de CSCL-omgeving, van interactieprocessen tussen leerlingen en van leeruitkomsten op een complexe manier met elkaar interacteren en dat het niet eenvoudig is om te ontrafelen hoe deze verschillende aspecten elkaar beïnvloeden. Verschillende andere factoren kunnen de gevonden resultaten beïnvloed hebben, zoals de ervaring van de leerlingen met CSCL, hun vaardigheden ten aanzien schrijven bij geschiedenis en samenwerken, hun ervaring met het gebruik van externe representaties voor het schrijven van een tekst en de invloed van de jaargroep. Daarbij omvatte de gebruikte opdracht veel verschillende activiteiten en het kan zijn dat de verschillen tussen de condities te klein zijn geweest om te resulteren in grote effecten, met name op een strenge maat als co-elaboratief historisch redeneren. Bij de generalisatie van de uitkomsten van dit onderzoek moet rekening gehouden worden met het feit dat dit onderzoek plaats had binnen één domein, met één type taak, met leerlingen van één niveau en met gebruikmaking van één type CSCL omgeving. Hoewel de uitkomsten van dit onderzoek enig inzicht geven in de mediërende rol van externe representaties bij een schrijftaak bij het vak geschiedenis, is behoedzaamheid geboden bij het generaliseren van de bevindingen naar andere domeinen, taken en CSCL-omgevingen (waaronder andere communicatievormen dan chat). Daarnaast was de keuze voor de representatievormen sterk gerelateerd aan het onderwerp en het doel van de taak. Andere representatievormen zouden meer geschikt kunnen zijn bij andere type taken en andere onderwerpen (bijvoorbeeld een causaal diagram bij een verklarende vraag).

Toekomstig onderzoek zou zich onder meer kunnen richten op: (1) de ondersteunende rol van representaties in CSCL in relatie tot domeinspecifiek redeneren en leren (b.v. Wat is de invloed van andere representatievormen op het ondersteunen van andere componenten van historisch redeneren en bij andere taken dan schrijftaken? Wat zijn kenmerken van representatie-tools om redeneren en leren in andere domeinen te ondersteunen, bijvoorbeeld bij aardrijkskunde en economie? Op welke wijze maken leerlingen gebruik van de gemaakte representatie bij het schrijven van de tekst?), (2) kenmerken van taken die historisch redeneren in CSCL kunnen ontlocken, (3) de invloed van kenmerken van taken en tools op het interactieproces en leeruitkomsten, en (4) de rol van ervaring met CSCL op het leerproces en leeruitkomsten.

Vanuit een meer praktisch oogpunt kan gesteld worden dat CSCL omgevingen met name bruikbaar zijn in de context van actief en zelfstandig leren en dat het samenwerken aan een schrijftaak (op basis van de bestudering van verschillende bronnen en uitgaand van een evaluatieve vraagstelling) duidelijk

een geschikte taak blijkt te zijn om historisch redeneren te ontlocken in CSCL. Verder blijkt dat het proces van historisch redeneren in zekere mate ondersteund kan worden door het samen maken van een externe representatie.

Ter afsluiting keren we terug naar de hoofdvraag van dit onderzoek, gericht op de faciliterende rol van CSCL ten aanzien van historisch redeneren. Met inachtneming van de bovengenoemde beperkingen van deze studie, kan geconcludeerd worden dat CSCL bruikbaar is om historisch redeneren te ontlocken en te bevorderen, omdat het zowel ondersteuning kan bieden aan cognitieve als communicatieve processen die nodig zijn voor de uitvoering van de taak. Aangetoond is dat binnen een dergelijke leeromgeving een samen schrijftaak, op basis van de bestudering van verschillende bronnen en uitgaand van een evaluatieve vraagstelling, een geschikte taak blijkt om historisch redeneren in CSCL te ontlocken. De hiermee ontlokte redeneerprocessen vinden niet alleen plaats in de communicatie-tool die gebruikt wordt (hier een chat-box), maar ook in en door de gezamenlijke constructie van producten zoals teksten en externe representaties. De kenmerken van de gebruikte representatie-tools spelen hierbij aantoonbaar een belangrijke rol in het vormgeven van het samen historisch redeneren. Samenvattend, het proces van historisch redeneren in CSCL wordt gevormd door het type vraagstelling, de gebruikte representatie-tools en de gevraagde en geconstrueerde producten.

SAMENVATTING

CURRICULUM VITAE

Jannet van Drie was born on August 5th 1972 in Ermelo (the Netherlands), and attended secondary school at the Christelijk College Groevenbeek in Ermelo from 1984 to 1990. From 1990 to 1994 she studied at the Christelijke Hogeschool Windesheim, where she received her qualification for teaching history at lower secondary education. She continued her studies at the Department of Educational Sciences at Utrecht University, where she graduated cum laude in 1997. Her Master's thesis dealt with collaborative concept learning in history. In 1998 she received her certificate for history teaching at higher secondary education at the IVLOS Graduate School of Teaching and Learning, and subsequently taught history at the Werkplaats in Bilthoven and St. Bonifatius College in Utrecht. From 2000 to 2005 she worked as a PhD student in the department of Educational Sciences at Utrecht University. Her research focused on computer-supported collaborative learning in the domain of history. Her paper *Supporting historical reasoning in CSCL* was nominated for "Best Student Paper" at the CSCL Conference in Bergen, 2003.

Since 1998, Jannet has also been working for the Dutch National Institute for Curriculum Development (SLO), and contributed to various innovative projects related to history education. She is a member of the Advisory Board of the Netherlands Institute of History Didactics (IVGD), and a member of the consulting board of the journal *Computers in Human Behavior*.

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¹¹ This article is included as Chapter 5 of this thesis.

¹² This article is included as Chapter 6 of this thesis.

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