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Interaction in Online Learning Environments: How to Support Collaborative Activities in Higher Education Settings

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Abstract

This study explored interaction and learning in computer-supported collaborative learning environments. It involved three different research projects based in higher education settings. The aim was to study, in particular, learner interaction and the way in which learners built and maintained common ground so as to enable themselves to collaborate and learn together. Another aim was to explore the effects of scripting interaction in online learning environments with a view to finding out how scripting can enhance or hamper collaborative interaction.

The five substudies were carried out as parts of three projects involving higher education courses. The first project (Substudies I and II) had student teachers constructing, in the context of an online learning course, case-based descriptions of areas such as the learning context, technology in education, and teachers' professional growth. The students' learning task was to discuss their assigned case and sum up their discussion twice during the online learning course. In the second project (Substudies III and IV), students attending another online course were required to establish joint research topics in the field of culture and communication and form subgroups to work together in a joint research project. In the third project (Substudy V), education students at the Ludwig Maximilian University Munich worked in an online learning environment as groups of three students, applying theoretical concepts from attribution theory to solve three authentic cases. Substudies I–IV were carried out in real-life teacher education contexts, whereas Substudy V was implemented in what was

more akin to a controlled experimental setting. The online courses observed in Substudies I–IV lasted two months, with the students accessing the online environments at different times and from different locations, whereas in Substudy V the students were simultaneously present at the 80-minute online session but spatially distributed in three different rooms in the same building.

The main data collected and analysed in all five substudies consisted of the record of the students' online discussions. The different documents produced by the individuals or groups and data on their learning outcomes were also exploited in analysing the materials. Substudies I, II and V were based on a combination of quantitative and qualitative methods. Substudies III and IV explored the activities of the small groups by using a qualitative approach.

All the five substudies indicated that interaction and collaboration in online learning environments are complex phenomena. In order to work together and interact successfully participants must engage in teamwork, making an equal personal contribution to the team's collaborative activities and freely sharing their prior knowledge, beliefs, assumptions and feelings. Here the mechanisms of the grounding process are basic elements which can enhance learners' ability to work as a team and reach shared understanding in knowledge building activities or whose absence can, on the other hand, hamper teamwork and the construction of knowledge (Substudies I–IV). The grounding process enabled the learners to face up, as they went about building and maintaining common ground, to a dual-problem space consisting of a content space and a relational space. Learners must focus on the content space in order to understand what their fellow learners are saying and, at the same time, give thought to what they should themselves say to the other learners and how they should say it so as to ensure that their learning partners grasp what they are themselves saying. On the other hand, they must understand the relational space of group work, representing what their fellow learners are willing and able to do and what they all can do as a group together and how their work will go forward efficiently. Besides this, individuals must attend to whether their fellow learners are willing and able to make contact, recognise the ideas and suggestions that are important, and willing to listen, react and respond. Further, participants must also know how to be present in the online learning environment and how to signal their presence in a suitable way.

The research results indicate that both individual learners and learner teams must put more effort into building and maintaining common ground. The mechanisms of common ground are used in different ways depending on the nature of the collaboration task, the make-up of the learners (whether peers, student-mentor teams etc), their previous relationships, the conditions under which they are collaborating (face to face, over computer), the collaboration setting (classroom, home etc), the form of communication used (synchronous, asynchronous) and the time period over which collaboration extends, (hours, days,

months). The effect of these different factors on the ways in which grounding mechanisms are applied needs further investigation. However, it seems that in the final analysis, it is the learners themselves who decide how much they want to exert themselves to build and maintain common ground.

In online learning courses where participants do not know each other, uncertainty among learners can influence collaboration in a number of ways. Learners' collaborative learning activities can be specified and sequenced by using scripts. The findings of Substudy V support the idea that epistemic (content-related) scripts reduce uncertainty. However, the results on student learning outcomes revealed that the learners in the unscripted condition had gained better learning outcomes than those in the epistemic script condition. It is possible that uncertainty promotes beneficial interaction patterns, including information-seeking processes. On the other hand, the members of the successful group might have excelled because they were willing to put in more effort to build and maintain common ground as they went about their collaborative activities.

The findings also revealed that the learners' collaboration activities rarely had a critical impact on their learning and that knowledge building between the learners seldom reached high levels of intensity and sophistication. Current educational culture tends to encourage university students to adopt a superficial and instrumental approach to their studies (Kanuka 2005; Mandl, Gruber & Renkl 1996), which might be one of the reasons why critically constructive and higher-level knowledge building was infrequent in the online learning environments examined in this study. Students may be unfamiliar with summing up agreements and opinions, elaborating ideas, and applying newly constructed knowledge. Even when they are both able and willing to engage in these processes, they might find it too challenging to perform them successfully through text-based communication (see Kanuka 2005).

Learning to collaborate is already being consciously promoted in higher education through the design of various tools or scripts supposed to help learners to interact and work together. However, learners may not be able to put such tools to appropriate and successful uses or do this without guidance if they are unclear about the basic rules of collaborative activities. As a result, even well-designed tools might fail to reach the goals set by their designers and by the educators who have taken them up. Further, the nature of collaborative learning suggests that its assessment should be based also on the interactive learning process itself (Chan & Van Aalst 2004). In other words, assessment should focus not only on the individual group members and their final product but also on the group processes. Moreover, account should be taken of both individual and group learning because different groups and different individuals inside one and the same group learn different things.

Keywords: collaborative activity, computer-supported collaborative learning, common ground, epistemic script, grounding process, higher education, interaction, uncertainty

Preface

When I completed upper secondary school, university was not the first option in my mind as a place where to continue my studies. Nevertheless, this was where I ended up after a long learning journey that is not over yet. I am grateful for so many people I met in different educational and work settings and in my private life. It seems that learning ever new things from other people is, for me, a never-ending road.

I would like to express my appreciation of my supervisors Professor Päivi Häkkinen and Professor Pauli Kaikkonen. Päivi, thank you for being such an encouraging and supportive person, who gave me a chance to do research based on my own interests and showed how to go about it. I did struggle a great deal with my research, but your encouraging words made me persist. Your support and care embraced not only my thesis but also my private life, of which you showed remarkable understanding. I was also lucky to have Pauli as my supervisor from the Department of Teacher Education. I extend my thanks to Pauli for his guidance and support and for his smooth organisation of all things involved in my doctoral studies.

My thanks go also to the reviewers of my thesis, Professor Paul Kirschner and Professor Eero Pantzar. Their valuable comments and criticism helped me to improve the final version of the thesis and decide about the direction that my work will take in the future. Knowing that I do have a long way to go, this was just a start.

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Leinonen and Johanna Pöysä, thank you for sharing your ideas with me and offering valuable comments on my texts.

“It’s qualitative, man!” The manifold things what I experienced and learnt during my research visit to Germany are impossible to measure easily and directly whether using quantitative or qualitative methods, but possibly a combination of these methods might do it. My warmest thanks go to Germany, to all my colleagues and friends there. I would like to extend my special thanks to Professor Frank Fischer, who warmly welcomed me to work there for a year. I was greatly impressed by his expertise and his dedication to research. I enjoyed working with Dr Armin Weinberger, whose valuable comments and insights challenged me to clarify my own thinking. My knight in shining armour, Ingo, who is always ready to listen to me, supported me greatly and helped me to survive in German research and daily life.

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I wish to express my special thanks to my friends and family. Despite the fact that sometimes distance and our own busy lives limit the amount of face-to-face contact, the feelings of togetherness never disappear. My deepest gratitude goes to all members of my family for the special and personal ways in which each of you supported me all these years. My warmest thanks to my Mom, Tarja, who believed in me, encouraged and supported me in many ways. Sari, I could not have a better sister and friend than you - thank you for being my big sister and sharing the special moments with me. My three nephews, the sunshine of my

life, Aatu, Eetu and Villematti, the time I shared with you is precious to me, you really got me to forget work for a moment. And my dear Peter, a distance relationship is not the easiest one, but over the last year it was the long phone calls on the evenings that kept me going with my struggles with the thesis. Thank you for being so loving and caring and being the one who gave me the final kick to finish my thesis.

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Jyväskylä, January 2006

Kati Mäkitalo

List of Empirical Substudies

This dissertation is based on the following substudies, referred to in the text by their Roman numerals:

- I. Mäkitalo, K., Salo, P., Häkkinen, P. & Järvelä, S. 2001. Analysing the mechanisms of common ground in collaborative web-based interaction. In P. Dillenbourg, A. Eurelings & K. Hakkarainen (Eds.), *European perspectives on computer-supported collaborative learning. Proceedings of the First European Conference on Computer-Supported Collaborative Learning*. Maastricht, The Netherlands: University of Maastricht, 445–453. (Refereed.)
- II. Mäkitalo, K., Häkkinen, P., Leinonen, P. & Järvelä, S. 2002. Mechanisms of common ground in case-based web discussions in teacher education. *Internet and Higher Education* 5 (3), 247–265. (Refereed.)
- III. Mäkitalo, K., Pöysä, J., Järvelä, S. & Häkkinen, P. 2005. Mechanisms of grounding processes in online conferences: A case study in teacher education. In R. Nata (Ed.), *Issues in higher education*. New York: Nova Science, 115–146. (Not refereed.)
- IV. Mäkitalo, K. 2005. *From multiple perspectives to shared understanding: A small group in an online learning environment*. Manuscript submitted for publication.
- V. Mäkitalo, K., Weinberger, A., Häkkinen, P., Järvelä, S. & Fischer, F. 2005. Epistemic cooperation scripts in online learning environments: Fostering learning by reducing uncertainty in discourse? *Computers in Human Behavior* 21 (4), 603–622. (Refereed.)

All five substudies are a part of the projects (SHAPE, ECOL and a project, based in Munich, Germany) where the data were collected and processed. The four co-authored articles (Substudies I–III and V) are based largely on the contribution of the first author. She analysed the data and reported the findings presented in Substudies I, II and III. The theoretical background to Substudy I was written in collaboration with the second author. In Substudy III

the second author collected the online notebook data (see Pöysä, Mäkitalo & Häkkinen 2003) included in the final research materials and cross-checked the findings made by the first author. The data used in Substudy V, collected in Munich, were offered for use in the first author's research during her one-year research visit in Germany. The results on the individual learning outcome data were a part of an earlier overview paper (Weinberger, Ertl, Fischer & Mandl 2005). However, all the process-related data exploited in the substudy and the qualitative and quantitative analyses are original and were not published in the overview by Weinberger and others. Some the data were analysed quantitatively in the German research group but were then reanalysed together with the first and second author, while the qualitative case-based analyses were carried out by the first author. The ideas underlying the theoretical framework and research questions of Substudy V were developed in close collaboration with the second and the fifth authors. The co-authors' main task has been to comment on the first author's work and offer her suggestions during the research and writing processes.

1

Introduction

Learning taking place in, for example, face-to-face situations around computers or in online learning environments is generally described as computer-supported collaborative learning (CSCL; e.g. Koschmann 1994). Computer-supported collaborative learning can be seen as a promising way to enhance teaching and learning practice in educational settings (Lipponen, Hakkarainen & Paavola 2004). The increasing popularity of online learning environments in higher education raises the question of how they should be used to support interaction and learning. According to several recent studies, collaboration promoted and supported by instructional technology has the potential to lead learners to deeper understanding and knowledge building (e.g. Crook 1999; Koschmann 1996; Scardamalia & Bereiter 1994). There have been optimistic views that any online interaction can be educationally valuable. However, more pessimistic appraisals of the quality of online learning have also been presented (Järvelä & Häkkinen 2002; Roschelle & Pea 1999; Stahl 2002). Previous research shows that the standard of online discussions is low and that discussion threads are short (Arvaja, Rasku-Puttonen, Häkkinen & Eteläpelto 2003; Hara, Bonk & Angeli 2000; Lipponen 2001; Stahl 2002). Discussion quality tends to be low because most of the messages exchanged by learners are based on experiences and feelings instead of theory and argumentation (Häkkinen, Järvelä & Byman 2001). According to Dillenbourg (2002), moreover, while non-structured interaction does not necessarily enhance learning, interaction and collaboration between learners might be affected negatively also by too much support or structure. It seems that there are several difficulties facing those wishing to employ online learning environments as a medium for productive interaction. Roschelle and Pea (1999) argue that online communication is highly text-dependent, and partly for this reason they also distinguish between (a)synchronous communication and face-to-face communication as distinct types of communicative activity.

Some of the most important processes underpinning human communication, such as the creation of mutual understanding or shared values and goals, are especially hard to reproduce in an online learning environment (Clark & Brennan 1991; Järvelä & Häkkinen 2002). The absence of visual information (e.g. facial expressions and nonverbal cues) increases also the social distance between participants (Clark & Brennan 1991; Järvelä & Häkkinen 2002; Rovai 2000). Nonverbal cues, facial expressions, gestures and posture are seen as important elements in face-to-face communication, where participants send and receive information by using and interpreting both verbal and nonverbal signals (Clark & Brennan 1991; Duncan 1969). These missing elements make text-based communication more challenging for learners, for example because of a lack of immediate feedback on how a message is received and how the other participants react to, understand and assess it and so on. Therefore, it is important to consider how text-based communication can be supported so as to enable learners to act collaboratively in online learning environments. Cognitive, interactional and social skills, required in working life, are all highly relevant to meaningful and productive collaborative activity (e.g. Archer, Garrison, Anderson & Rourke 2001; Arvaja 2005; Salomon & Globerson 1989). We should pay attention not only to the cognitive but also to the social level of communication as factors in how learners handle information and process it further as they act together in online learning environments. As Henri (1991) and Garrison and others (2001) point out, when communication, instead of serving only the exchange of information, becomes also a social process, this makes possible higher-level interaction, in other words collaborative interaction.

There are many reports that compare face-to-face and computer-mediated communication (e.g. Dietz-Uhler & Bishop-Clark 2001; Heckman & Annabi 2005; Jonassen & Kwon 2001; Ocker & Yaverbaum 1999; Sumner & Hostetler 2002). Accordingly, the research aim of this dissertation was not to find out which type of communication is better. Because online learning environments are becoming more popular in higher education, there is a need to investigate computer-mediated communication in this particular context. However, this study does not consider the associated technology as a value itself but, rather, as a mediating element and a communication and learning tool. It looks at a particular type of computer-supported collaborative learning which relies mainly on asynchronous and text-based communication, exploring the mechanisms used to establish and maintain common ground among learners, seen in the dissertation as a potential means of sharpening learners' joint focus and promoting their equal participation in collaborative activities and, therefore, of enhancing the quality of learner interaction in the higher education context. A further aim was to examine how shared understanding is built through collaborative activities and how scripting affects interaction and learning in higher education.

The five substudies making up this dissertation were a part of three research programmes, SHAPE, ECOL, and a Munich-based project. The first of them, SHAPE (Sharing and Constructing Perspectives in Virtual Interaction) was a three-year programme which investigated the nature and quality of virtual interaction in two educational settings, higher education and learning at work (Häkkinen, Järvelä, Kuure, Saarenkunnas, Salo & Taalas 2001). The analysis of the SHAPE data was continued in the second project, ECOL (Ecology of Collaboration: Collaboration as Motivated and Co-Ordinated Activity in Learning in Higher Education and Workplace Contexts), which looked at, among other things, collaboration as a co-ordinated activity, motivational processes, and shared understanding in collaborative learning (Järvelä & Häkkinen 2003). The purpose of the third research project, based in Munich and Tübingen, Germany, was to explore ways of supporting the processes and outcomes of online collaborative learning by using different kinds of script (Stegmann, Weinberger, Fischer & Mandl 2004; Weinberger 2003; Weinberger et al. 2005). The present dissertation draws on the data collected in these projects.

2

Structure of the Dissertation

The dissertation has two parts. The first part introduces the study, discusses its theoretical background, aims and methods, and presents its general conclusions. The second part comprises five empirical substudies of computer-supported collaborative learning among university students. The research objectives were:

1. to describe and analyse grounding processes, scripting and learning among university students operating in online collaboration environments and
2. to develop pedagogical models for describing learner collaboration processes.

The quality of learner interaction is not the only focus of the study; the aim is also to make sense of the ways in which learners employ discourse to design collaborative learning activities. Rather than focusing on a limited range of issues arising in online learning environments, the study offers a more general discussion of the interaction- and learning-related concerns associated with settings of this kind.

3

Theoretical Framework

3.1 Computer-Supported Collaborative Learning

Interaction intended to enhance learning that takes place at computers or through computers is generally discussed under the term computer-supported collaborative learning (CSCL; Koschmann 1994). Computer-supported collaborative learning applications can be used in a variety of settings, such as in the classroom, across classrooms and outside classrooms (Koschmann 1994). Interaction based on computer applications and computers, which may be called computer-mediated communication (CMC), can be classified into two categories. In synchronous CMC, such as chat, learners are all online simultaneously, while in asynchronous CMC (e.g. e-mail and threaded web discussions) learners are able to participate without being bound by the constraints of time and space. Computer-mediated communication is mainly text-based, which distinguishes it from, for example, the exchange of traditional printed information (Hathorn & Ingram 2002). The distinction arises because users engaging in computer-mediated communication develop their own style, which may be characterised by abbreviated writing and emoticons (e.g. :, :-), :() (Hathorn & Ingram 2002).

Collaborative learning is seen as an active process where learners enter into a joint activity and adopt common goals that bring them together to perform tasks or solve problems (e.g. Barron 2000; Crook 2002; Dillenbourg 1999; Koschmann, Myers, Feltovich & Barrows 1994; Roschelle 1992; Scardamalia & Bereiter 1994). Collaboration is described as a coordinated effort where participants pursue joint goals and solve shared problems and build mutual understanding of some particular issue (Dillenbourg 1999; Littleton & Häkkinen 1999). Apart from the expression mutual understanding, collaboration is discussed under

terms such as joint problem spaces (Roschelle & Teasley 1995), joint knowledge building (Baker 2002; Crook 2002), shared meaning-making (Stahl 2003), collective thinking (Mercer 2003) and coordinative interaction (Barron 2000). It seems that the purpose of collaborative activities is to produce or discover something, solve a problem or create something and work together in order to achieve shared goals and shared understanding and knowledge.

Online learning environments are considered to promote collaboration. They can, for example, enhance collaborative learning in higher education by providing shared workspaces where learners can work together on authentic problems (Strijbos, Kirschner & Martens 2004). Critics have argued that online collaborative learning environments are too often seen as representing a setting for social interaction which automatically leads to deeper understanding and the construction of new knowledge (e.g. Kreijns, Kirschner & Jochems 2003; Stahl 2002). In other words, online learning environments do not, as such, guarantee that learners will in fact interact with each other (Kreijns et al. 2003). A number of studies have demonstrated, in different online learning contexts, activities consisting of low-level discussions and short discussion threads and limited sharing of knowledge (e.g. Arvaja et al. 2003; Hara et al. 2000; Lipponen 2001; Stahl 2002).

Learners operating in online learning environments are often strangers to each other and are faced, besides a new environment, with problem-solving tasks that might also be new to them. An online situation lacks, among other things, the nonverbal cues and immediate feedback seen as crucial in a face-to-face situation where people are pursuing joint goals and shared understanding (Clark & Brennan 1991; Duncan 1969; Järvelä & Häkkinen 2002; Roschelle & Pea 1999). The importance of nonverbal cues was demonstrated in a recent study of a 3-D virtual environment where the provision of nonverbal cues in an online learning environment resulted in a more flexible communication process and enhanced the learners' motivation (Allmendinger, Troitzsch, Hesse & Spada 2003).

In text-based communication, a learner receives no immediate feedback on how the other learners understand and react to the learner's contributions, which might prevent the learner from establishing social contacts with their fellow online learners, reach joint goals and achieve shared understanding. Online learning environments, which often entail physical distance between a learner and the learning environment and between individual learners within it, offer no immediate feedback or nonverbal cues, potential generators of fruitful interaction (e.g. Järvelä & Häkkinen 2002; Mäkitalo, Pöysä & Häkkinen 2003; Roschelle & Pea 1999). In spite of all these issues, online learning situations are often expected to bring about effective learner participation. However, the absence of nonverbal cues and immediate feedback makes online communication a distinctive type of human interchange whose special features challenge designers, researchers, teachers and learners involved in computer-supported collaborative learning. From this perspective, online learn-

ing environments can be considered as complex interaction situations where learners have to put more effort into establishing and maintaining successful communication. Collaborative learning calls for a deeper understanding of the relationship between social interaction and knowledge construction and makes necessary a closer practical link between these two processes (Dillenbourg 1999). There is also a need to pay more attention to interactive processes and especially to those mechanisms which could enhance and maintain interaction and its connection with learning (Baker 2002).

3.2 Preparation of Common Ground

Social interaction starts at the point when learners have found an adequate extent of *common ground* (Clark & Brennan 1991; Clark & Schaefer 1989). During the *grounding process* (the process of interaction) individuals build and maintain their common ground by sharing their understanding, knowledge, beliefs, assumptions, and presuppositions (Baker, Hansen, Joiner & Traum 1999; Clark & Schaefer 1989). It seems that common ground is basically about understanding, as a precondition of successful interaction, what a fellow learner means by a specific statement or sentence (Clark & Schaefer, 1989). Dillenbourg (1999) argues that building and maintaining common ground is a precondition of successful learner collaboration. Grounding obliges learners to coordinate both content and process (Clark & Brennan 1991); a certain extent of common ground is required before learners can solve problems and perform tasks together. Not only do they work out shared goals, they also develop a group awareness of the goals they share (Häkkinen, Arvaja & Mäkitalo 2004). Thus, while learning partners never reach a level of totally shared understanding (Clark & Schaefer 1989), in order to work together they must exchange evidence about their own beliefs and assumptions. The process of grounding seems to be especially important to those learners who are not very familiar with each other and who work at distance (De Jong, Kollöffel, Van der Meijden, Kleine Staarman & Janssen 2005). In this study, common ground encompasses collective actions performed by group members to reach and maintain shared understanding within the content and relational spaces. Thus, common ground also involves becoming aware of the goals that the group members share in collaborative learning situations. (Barron 2003; Brennan 1998; Clark & Brennan 1991; Clark & Schaefer 1989; Häkkinen et al. 2004.) The study draws on a theoretical framework constructed by Clark and his colleagues which provides a systematic approach to modelling communication between individuals or even between humans and machines (Brennan 1998; Clark & Brennan 1991; Clark & Schaefer 1989), adapted here for a focus on interaction between individuals working collaboratively in online learning environments.

3.2.1 From Common Ground to Group Cognition

The varied range of terms such as common ground, shared understanding, shared knowledge and shared problem spaces serves to describe a situation or process consisting of or a product that is the outcome of collaborative activities. Many researchers have used “common ground” and “grounding” in the sense of shared understanding, shared knowledge or shared meaning-making or group cognition (e.g. Baker et al. 1999; Beers, Boshuizen, Kirschner & Gijsselaers 2005; Dillenbourg & Traum 1999; Jeong & Chi 1997; Mulder 2004; Stahl 2003; 2005). According to Dillenbourg and Traum (1999), at the linguistic level shared understanding is about being able to grasp the meaning of a sentence or a word in a sentence. At the cognitive level, it means being able to make sense of a problem or its solution or of a domain (Dillenbourg & Traum 1999). Their study discusses both the linguistic and the cognitive level of grounding, but they refer also to its social level, involving two participants’ mutual belief that their meaning has been understood by the other participants adequately enough for the current purposes. Baker and others (1999) describe common ground as a set of mutual beliefs among a group of participants about what their utterances mean during conversation. They go on to characterise grounding as an interactive process where individuals construct and maintain mutual understanding (common ground).

Beers and his colleagues (2005) consider that shared knowledge is knowledge held in common by a group. The recognition by a group of learners that they have shared knowledge is a phase which leads them to build common ground (shared understanding) and construct further joint knowledge. This view is accepted also in a study by Jeong and Chi (1997). As they see it, learners first share a particular knowledge base, after which they should be familiar with it, making this knowledge base common among the learners. Mulder (2004, p. 17) defines shared understanding as follows: “Reaching (and maintaining) shared understanding is defined as the process (multidisciplinary) team members employ to gain new understanding or correct, improve, or enrich the current team understanding, and thus collaboratively learn and collaboratively reflect.” In her study she sees shared understanding as an outcome of a collaborative learning process. Van Der Pol, Admiraal and Simons (2003) describe grounding as an activity where learners, through online discourse, elaborate the meaning of a set of scientific concepts in order to reach mutual understanding and valid interpretations (called in the study semantic grounding). They see grounding also as a pragmatic process that results in a mutual understanding among learners of the individual intentions that underpin their conversation. Further, Van Der Pol and others argue that common ground can be found by providing a frame of reference, for example when discussions between and the literature used by a group of learners are cross-linked with each other. Pfister (2005) considers that in successful grounding, new information contributed by an individual learner becomes a part of the group’s common ground

(shared knowledge). Thus, it depends on the goal pursued in a discussion whether a given piece of information will become an element of common ground (Pfister 2005).

Stahl (2003) suggests that processes of shared meaning-making generate collaborative learning when there is a dynamic relationship between shared meanings and individual interpretations. Shared meaning-making is a term which is replacing those of shared knowledge or shared understanding. In collaborative activities learners must recognise the meanings of artefacts which exist in a shared intersubjective world and interpret these meanings from their own personal perspectives (Stahl 2003). In another study Stahl (2005) describes a meaning as a shared group product constructed during successful collaborative activities through the interactions of individual group members, not by the individual members on their own. He offers an account of how group cognition emerges in practice. In analyses of case studies of collaboration, group cognition functions more as a unit of analysis than as a group mind of some kind. Stahl asserts that group-level analyses often show that an individual's apparently isolated acts are actually mediated by important social considerations.

Clark and Schaefer (1989) are more interested in the interaction process itself as a factor enhancing communication. According to them (1989, p. 259),

A closer look at actual conversations ... suggests that they are much more than sequences of utterances produced turn by turn. They are highly coordinated activities in which the current speaker tries to make sure he or she is being attended to, heard, and understood by the other participants, and they in turn try to let the speaker know when he or she has succeeded. Contributing to a discourse, then, appears to require more than just uttering the right words at the right time. It seems to consist of collective acts performed by the participants working together.

Many researchers have applied this theory derived from communication science because it explains why it is important to build an adequate extent of common ground or, as it is also referred to, shared understanding as a means of enhancing communication between learners. Baker and others (1999) illustrated a computer-mediated collaborative learning situation by applying different theories of grounding taken from linguistics and the cultural-historical activity theory. They demonstrated that the model developed by them can be used to explore grounding, collaboration and learning in situations exemplified by two students chatting together. The students' computer-mediated conversation was synchronous, real-time. The approach adopted by Baker and his colleagues emphasised the role of language in human interaction and thinking. From the point of learning, a cognitive-interactional effort is needed before learners can understand each other and the function of the semiotic tools that are seen as the mediators of interpersonal interaction (Baker et al. 1999). The

article was chiefly a description of what happened at the linguistic level as the participants interacted, paying less attention to how learners collaboratively reach mutual understanding as a preliminary stage to building new knowledge.

Dillenbourg and Traum (1999) and Beers and his colleagues (2005) focused on how different tools can support grounding processes in online learning environments. Dillenbourg and Traum (1999) evaluated the way in which a group of learners carrying out a collaborative problem-solving task employed a shared whiteboard where they could display text, graphics and diagrams and the like. The assumption was that the whiteboard would facilitate grounding processes and, therefore, promote the construction of a shared solution to the problem assigned to the group. The results show that the use to which the whiteboard was put was not related to the problem-solving outcomes, serving, instead, mainly as a tool in the problem-solving process. Beers and others (2005) examined how different versions of a negotiation tool helped a group of learners to make their own representations and opinions explicit in their pursuit of common ground and shared understanding. It was found that the negotiation tool affects the processes of negotiation and building common ground. The findings show that the participants found more common ground when their negotiation tool compelled them to negotiate the meanings of their contributions.

Pfister (2005) investigates how learners can be assisted to ground discourse and find adequate common ground in online discussions. The results of his study suggest that learners must be willing to exert themselves to achieve grounding and that if they are unable to trade their efforts for expected gain, what they have put in will not be available for other cognitive activities. Finally, it is up to the learners themselves, when they consider it appropriate, to activate one or more of the grounding opportunities offered by the system. Jeong and Chi (1997), again, analysed the ways in which learners construct shared representations during collaboration and what extent of sharing improves learning in a face-to-face situation. According to them, building common representations by co-constructing shared mental models and knowledge seems to be one of the mechanisms which explains how learners learn during collaboration. In the light of their study, the grounding process enabled the learners to co-construct mental models and knowledge.

Koschmann and LeBaron (2003) criticise what they call Clark's contribution theory, better known as involving the constructs of common ground and grounding. They view the notion of common ground as a confusing metaphor rather than as a useful explanatory mechanism, considering that the concepts of grounding and common ground should be substituted with more descriptive accounts of joint activity because Clark's terms can be interpreted in too many ways. Stahl (2003, p. 531) responds to their criticism by pointing out that "clarity about the distinction between intersubjective meaning and its interpretation from personal perspectives can avoid that confusion". Nardi (2005), again, sees Clark's theory of common ground as information-based, with the given information enabling

learners to understand each other. She goes on to argue that linking connection and common ground might provide a more comprehensive theory because common ground focuses exclusively on shared information, while connection operates as a relational element, which might offer a better explanation of how interaction is maintained over time.

It seems that previous research on common ground and grounding concentrates mainly on the cognitive-level achievement of shared understanding or shared knowledge in collaborative activities. However, the social and emotional aspects of collaboration should also be taken into consideration, not to mention its contextual features (see also Nardi 2005). There has been less research in the CSCL field that would explore the mechanisms of establishing and maintaining common ground through analyses of the different features of online conferences. There is no specific theory which would explain how discourse can be made efficient, improving learning. Because we are faced with a multiplicity of phenomena associated with interaction and learning, there is a need to work out a theoretical framework, reconstructed from other theories taken from different fields, to account for what happens in collaborative activities, why it happens, and what might be the outcomes of each particular type of constituent action.

The grounding process has been described in settings where communication is seen as a form of collaborative action (Brennan 1998; Clark & Brennan 1991; Clark & Schaefer 1989). Grounding is a matter of collective action rather than just a sum of isolated and individual collaborative learning acts (Baker et al. 1999). When two or more people are working together, they must coordinate not only the content they are engaged with but also the working processes associated with their engagement with this particular content. To coordinate content they must share information or find common ground by drawing on joint beliefs, assumptions and knowledge. Further, they must update their common ground step by step if they are to successfully synchronise their processes of work. According to Clark and Brennan (1991), building common ground is the aim of all collective activity. Moreover, in accordance with the principle of least collaborative effort, participants should try to prepare common ground with as little effort as possible. According to Clark and Brennan (1991), different media can affect individuals' methods of communication, but this does not mean that they would not be able to communicate effectively by means of any media. Clark and Brennan found that the amount of effort required varied depending on the available communication media. Further, participants should establish and maintain common ground with those techniques which are available in a medium that calls for least collaborative effort. (Clark & Brennan 1991.) Dillenbourg and Traum (1999) observe that learners should exploit various grounding techniques more vigorously if the costs of non-grounding are high. More specifically, learners taking part in an online conference must consider the benefits of grounding as against the costs of non-grounding. These costs are linked to the mechanisms of common ground, collective acts which help to build and maintain com-

mon ground among online learners, focusing on the coordination of both learning contents and the learning process.

3.2.2 Establishing and Maintaining Common Ground

This dissertation has applied certain assumptions from previous studies of grounding processes concerning the ways in which common ground is established and maintained (e.g. Allwood, Nivre & Ahlsén 1991; Baker et al. 1999; Brennan 1998; Clark & Brennan 1991; Clark & Schaefer 1989). The uses to which these grounding mechanisms are put may vary depending on the purpose of the given collaborative activities and the medium where the collaborators interact (Clark & Brennan 1991). The aim of this study is to describe the mechanisms that learners bring into play in order to create and sustain common ground and that are important in computer-mediated communication. Such features as short discussion threads, superficial discussions and limited sharing of knowledge, reported in previous studies, might be one result of a lack of joint focus and shared understanding among learners communicating by computer. Grounding mechanisms, designed to generate learner interaction and collaboration, could also enhance learners' joint focus on their collaborative activities. The next chapter introduces the mechanisms that establish common ground, the one after that the mechanisms that maintain it.

3.2.2.1 Mechanisms for Establishing Common Ground

The mechanisms for establishing common ground are three: 1) *the presence of another*, 2) *processes of diagnosis* and 3) *feedback* (Baker et al. 1999; Brennan 1998; Clark & Brennan 1991). First of all, participants in a shared activity must be aware of the (virtual) *presence of another*. In a face-to-face situation learners share the same physical setting and are able to see and hear one another. In online environments, where communication is still mostly text-based, this is not possible (Clark & Brennan 1991). This might make learners less conscious of each other's presence. Other studies employ the term social presence to describe a human being's degree of awareness of another person engaged in interaction with them (Walther 1992) or, like Tu and McIsaac (2002), define it as the amount of feeling, perception and reaction associated with being linked with another person in online communication. Social presence has been explored in search of ways to influence online interaction, learner involvement, the quality of discourse among learners, and learners' sense of community (e.g. Garrison et al. 2001; Gunawardena 1995; Kreijns et al. 2003; Rovai 2000; Tu 2002; Tu & McIsaac 2002). Social presence is seen as a source of group cohesion and hence of enhanced interaction. According to Tu (2002), there are several variables controlling the degree of social presence, among them the possible presence of authority figures, access to

or the location of the interaction setting, the amount and length of messages sent among the participants, message styles, and the size of the discussion group. As used by Tu (2002), social presence is a wider concept than that of the presence of another, which seems to be one of the elements of social presence. Archer and his colleagues (2001) observe that an understanding of the meaning and function of social presence in online learning environments helps to make these environments operate more effectively in educational contexts. In this dissertation, the presence of another is defined as learners' awareness that they are involved with real people with whom they should communicate and as the ways in which they personally make themselves visible to each other.

Secondly, participants active in virtual environments must consider not only what they are saying but also about how they are saying it, which leads us to the *processes of diagnosis*. Learners need to think carefully about what they are saying and how they are saying it so as to prevent misunderstandings and avoid hurting other learners. This is because there are no signals such as contextual and nonverbal cues to help learners observe how their addressee is reacting and moreover, they are not able to correct their phrasing directly. Learners should create carefully thought-out contributions that will be readily and clearly understood by addressees (Clark & Brennan 1991). In face-to-face situations, participants usually draw on contextual and nonverbal cues of all kinds to modify their contributions and check how the other people are reacting. Online communication is still mainly written and immediate feedback is missing, making it harder for participants to reach common ground. Learners may find it difficult to frame written messages that are easily understood by everyone and that exclude any misinterpretations and misunderstandings. Clark and Brennan (1991) assume that learners are unwilling to put more effort than needed into the mechanisms of the processes of diagnosis. Learners try to avoid superfluous effort by minimising their collaborative exertions, for example because of pressure of time. They plan and send their messages using only so much time and effort, which might lead them to contribute inappropriate messages. To prevent too many errors, learners should simply apply themselves and take their time to prepare understandable contributions. Time spent on this might also turn out to be time saved because it would do away with the need to repair infelicitous messages. A specific factor hampering online communication is that most if not all people find it more laborious to type an utterance than to speak it out. It also costs time and effort to formulate and refine simple utterances until they are faultless. Some learners might also have difficulties starting a new discourse. To make appropriate contributions, learners must be adequately familiar with their learning partners (their background, expertise, cultural, historical and situational characteristics etc; see Säljö 2001; Mercer 2003) and also with the issues that they and their partners are collaborating on, something that is not always the case in collaborative learning groups.

The third essential mechanism for establishing common ground is *feedback*. Discussion participants must make their attitudinal and behavioural reactions and understanding known through some form of feedback (Baker et al. 1999; Brennan 1998). Thus, if everything is going smoothly, feedback can be a simple acknowledgement that a message has been received. Even in such a case, there must be some feedback to prevent the contributor from falling prey to undue doubts about whether the other participants are reading their messages, and also to promote mutual understanding (Brennan 1998). In an interactive situation, a contributor does not know if they have succeeded in getting their message across unless an addressee provides some evidence that communication is working by offering feedback (Clark & Brennan 1991). Feedback is described as one of the basic elements in any interactive context. In a face-to-face situation, people use nonverbal signals as feedback. Zumbach, Schönemann and Reimann (2005) developed a feedback mechanism for fostering collaborative behaviour. Their results show that their mechanism led to better solutions to problems and improved the group climate. A study by Mulder, Swaak and Kessels (2004), again, found that feedback (confirmation, paraphrasing, summarising, explaining, reflecting, checking for understanding and checking actions) was one of the elements which had a positive impact on the process of reaching shared understanding during video conferences.

3.2.2.2 Mechanisms for Maintaining Common Ground

Successful interaction in online environments presupposes an adequate amount of common ground. However, even after common ground has been built, there is no guarantee of a steady flow of such interaction. In fact, common ground between learners needs to be maintained during online conferences. Mechanisms considered to accomplish this include *contact*, *perception*, *understanding* and *attitudinal reaction* (Allwood et al. 1991). In situations where there is an intention to maintain common ground, these mechanisms can be seen as a part of feedback, as Allwood and others initially argue.

Contact refers to a state of affairs where participants engaged in online collaboration are willing and able to continue their interaction. Dillenbourg and Traum (1999) use the term *access* when speaking about learners' awareness that they and their fellow learners have access to a shared space in an online learning environment. The mechanism of *contact* can be related also to that of *presence*. If learners are not able to access the online learning environment and make their presence visible, leading to excessively long pauses between contributions, some of them may drop out of the online conference, generating delay costs (Clark & Brennan 1991). For example, McMillan (1996, p. 322) considers that "contact is essential for a sense of community to develop", arguing that it produces a sense of "all for one and one for all".

Perception indicates a situation where participants are willing and able to read a message that has arrived in an online environment (Allwood et al. 1991). Online environments can display dozens of messages and sometimes it is a challenge to find the relevant messages among the rest. According to Dillenbourg and Traum (1999), perception also enables a learner to safely presume that another learner has noticed their message and read it. To avoid message jams learners should regularly look up new messages and also leave some mark that tells the contributors that their messages have been received and read (see Tu 2002). They might, for example, send some simple feedback. Clark and Brennan (1991) assume that reading is harder than listening, that is, that the costs of reception are higher in online learning environments than in face-to-face situations. At the same time, online environments may make it easier to read complicated utterances because it is possible to browse back and forth across a message.

Understanding refers to participants' willingness and ability to make sense of a message (Allwood et al. 1991). Understanding is here something more than simply comprehending a given set of words; the language that people employ is loaded with, and thus mediates, historical and cultural meanings. Also, situational factors can be interrelated with understanding (Säljö 2001; see also Crook 2000). In other words, the linguistic code is always someone's interpretation of something (Säljö 2001). Here, the focus is on individual understanding or individuals' own interpretations of a particular situation, which should not be confused with shared understanding. Shared understanding is built from individual perspectives as several individuals engage in group discourse. Understanding is one mechanism among others but also an important ruling mechanism for generating shared understanding in a group. Clark and Schaefer (1989) list five main types of evidence suggesting that understanding has indeed emerged: 1) continued attention, 2) initiation of a relevant next contribution (at a level of sophistication as high as the message responded to), 3) acknowledgement (a fellow learner nods or says "uh huh" etc), 4) demonstration (another learner demonstrates all or a part of what they have understood the other learner to mean) and 5) display (a verbatim display of the previous contribution). Some of these types of evidence are hard to articulate in text-based communication. One of the advances brought about by asynchronous online environments is that learners have time to read messages in peace and can go back and forth in the message forum, enabling them to make a serious attempt to understand what the other contributors are saying. However, reading and acknowledging a message do not necessarily mean that the receivers have understood the sender. Therefore, learners should seek evidence that their messages have been taken in by their receivers but also provide evidence of their own understanding or lack of it regarding the messages of their fellow learners (Brennan 1998). Learners should exchange evidence of mutual comprehension until they have come to the conclusion that they are indeed talking about the same thing (Clark & Schaefer 1989). It is said that learners never understand each

other completely, but some degree of shared understanding is necessary before it is possible to successfully perform a task together.

The costs of understanding may be higher in online learning environments (Clark & Brennan 1991). Because there are no nonverbal or contextual cues, learners must put in more effort to understand message contents. Moreover, if a learner grasps what their fellow learners are trying to say, these should be able to see it. In this context, providing one's learning partners with feedback is also important. At the same time, learners should not shun a degree of misunderstanding and conflict because such situations may lead their discourse to a deeper level, thus enhancing learning (e.g. Dillenbourg 1999; Piaget 1977).

Attitudinal reaction covers participants' willingness and ability to react and respond to fellow learner's messages (Allwood et al. 1991). All these mechanisms of maintaining common ground are linked: an attitudinal reaction between people cannot take place unless a message has first been understood (or at least interpreted), which requires perception and contact. And vice versa, all the other maintenance mechanisms influence learners' attitudinal reactions. In collaborative activities, learners must be willing to respond irrespective of whether they understand or fail to understand a contribution. Especially when a learner cannot make sense of a message, they should be ready to spend some effort to ask the contributor to explain or verify the message so that they can reach some degree of shared understanding. Equally, if learners are ready to exert themselves and engage in group discourse they will find a way to access their shared online environment and make contact and will also read all the messages, though it might take some time. If they are truly willing to interact with their fellow learners, they will overcome all these obstacles.

Especially in asynchronous communication where learners have no physical contact, and access the online learning environment whenever it suits them, these mechanisms can promote their joint focus and make for more active group interaction. As Clark (1996) defines it, grounding seems to be a functional process; interaction cannot be successful unless learners are ready to apply themselves to the construction and maintenance of common ground.

Figure 1 displays the elements that should be taken into account in grounding processes in online learning environments. According to Clark and Schaefer (1989), it is the learners themselves who decide whether building common ground makes sense and whether they are ready to put some time and effort into avoiding the costs of non-grounding. Grounding mechanisms are connected with the management of interaction, an important aspect of collaborative activities. Thus, the foundations of the grounding process are factors that shape the design of and the pedagogy appropriate for online learning environments. In such settings, it is the task to be performed, the situation where it is to be carried out and the tools that are available for accomplishing this that determine the way in which grounding takes place (Baker et al. 1999; Clark & Brennan 1991). The quality of online discussions can sim-

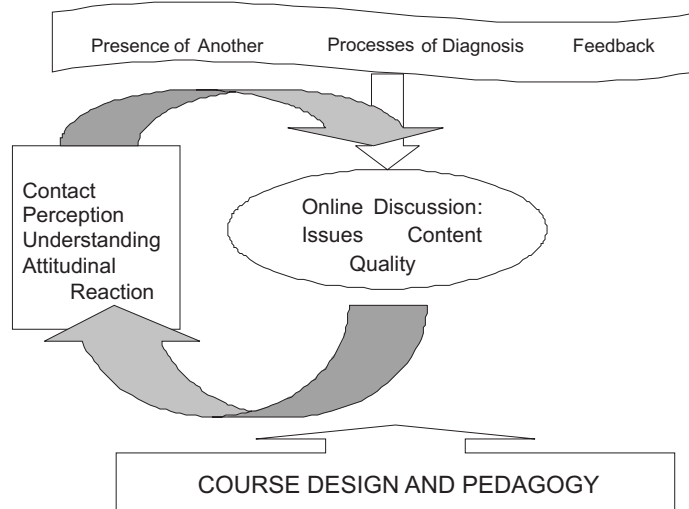


Figure 1. *Mechanisms for establishing and maintaining grounding processes in online learning environments.*

ilarly be seen as a factor enhancing or reducing learners' willingness to create and especially sustain common ground. There is also a need to consider the immediate environment where collaborative activities unfold, helped along by artefacts, technologies and action spaces (Crook 2000; Mercer 2003; Stahl 2005; Säljö 2001; Vygotsky 1978).

3.3 Shared Understanding and Contextual Features in Collaborative Learning Situations

Collaborative learning has been seen as a facilitator of deeper and critical thinking, for example in the context of studying subject matter (Barron 2000; Garrison et al. 2001; King 1999). In order to solve a problem or perform a task together learners must undertake actions of different kinds, for example agree on common terms of reference, resolve any problems interfering with mutual understanding and negotiate a joint interpretation of the group task, arrive at a joint solution to the problems involved and achieve a joint outcome (Koschmann, Kelson, Feltovich & Barrows 1996; Miyake 1986; Roschelle 1992; Roschelle & Teasley 1995). Roschelle (1992) argues that learning outcomes emerge in a process where conversational convergence and conceptual change are integrated. In collaboration, learners not only share perspectives but also challenge and refine those perspectives. When they challenge each other's viewpoints, this forces those challenged to exert themselves to produce shared meanings (O'Malley 1995). Collaboration is not successful unless it leads to

something new being envisioned and created or something new being produced (see Murphy 2004). Collaborative efforts to understand and solve problems are necessary when building knowledge in groups (Koschmann, Zemel, Conlee-Stevens, Young, Robbs & Barnhart 2005; Mercer 2003; Schwartz 1995; Vygotsky 1978). When a group of people engaged in collaborative activities are constructing a shared problem space, they must tackle multiple perspectives by discussing them and accepting their existence (Barron 2003). As Bromme (2000) sees it, a group pursuing shared understanding needs some common ground, a shared cognitive frame of reference. These multiple individual understandings must be articulated as the participants produce shared understanding through cycles of displaying their individual points of view, involving, for example, negotiation, confirmation, repair, acceptance and so on (e.g. Barron 2003; Beers et al. 2005; Bromme 2000; Dillenbourg 1999; Koschmann et al. 2005; Roschelle 1992). Therefore, in collaborative learning it is essential to find an adequate extent of common ground by means of grounding processes (e.g. Clark & Brennan 1991; Dillenbourg 1999).

Because collaborative learning is a complex process, there are a variety of theoretical approaches to CSCL (Lipponen et al. 2004; Stahl 2004). However, two main theoretical perspectives on collaboration have emerged, based on Piaget's and Vygotsky's ideas respectively (see Lipponen et al. 2004). The Piagetian viewpoint concentrates on the cognitive processes of individuals (Piaget 1977). Individuals' construction of knowledge is enhanced when they interact with other learners, stimulating their knowledge elaboration. According to Piaget, knowledge construction takes place when learners adjust their knowledge base to the current context by revising their existing knowledge structure or concepts or by generating new knowledge. Piaget's ideas have been adopted by the socio-constructive approach. The main focus is on individuals and their personal process of constructing knowledge and learning.

Vygotsky's (1978) ideas, again, were taken up by the socio-cultural approach, which highlights the nature of knowledge construction and the roles of artefacts in the collaborative construction of knowledge. Thinking is seen as a social process grounded on conceptual and material resources derived from the thinkers' culture (Säljö 2001). Therefore, if we are to understand learning we must explore how people adapt the artefacts of action and thinking available in their own culture and society to new contexts. According to Stahl (2005), socio-cultural perspectives indicate that learning and cognition are possible both at the level of groups and communities and at the level of individuals.

Stahl (2004) describes collaborative knowledge building as a cyclical process where individual perspectives or understandings are made visible. Building a shared understanding of comprehensible issues involves the expression of individual understandings with the help of psychological artefacts such as concepts. In this process, learners verify and negotiate their individual views so as to reach shared understanding or group cognition (Stahl

2005). The shared understanding thus negotiated becomes the learners' tacit knowledge, available as a resource for building further new understanding. Thus, collaborative knowledge building involves analysing and elaborating any issues at hand through continuous interpretive processes mediated by linguistic, cognitive, cultural, physical and digital artefacts (Stahl 2002). This means also that learning is connected with the situation where it happens and that it should not be evaluated separately from the context created by the learners operating in this particular situation (e.g. Koschmann et al. 2005; Chan & Van Aalst 2004).

Mercer (2003) similarly emphasises the role of context in collaborative activities. According to him, learners should themselves build the foundation, the context, for their subsequent joint activity (see also Dillenbourg 1999). Such a contextual foundation encompasses more than the physical environment where language is used. A context is a mental phenomenon where listeners or readers are making sense of what is being said or written by exploiting whatever information they can access. Mercer (2003) continues that when learners interact with each other, a context invariably emerges. This is a challenge in collaborative learning situations where students come from different universities and even from different countries. As a result, they have no previous shared contextual foundation. Instead, if the students want to collaborate successfully they must immediately start building one, which requires time and effort. Mercer considers that active cooperation in the construction of a shared context is necessary if the students are to collaborate successfully on solving problems together or on discussing or concluding their joint task. Further, the resources available for bringing about a context shared between the students include any knowledge that they might have of shared history, to which they can appeal directly or indirectly. Such common knowledge functions as a collective frame of reference; it might consist of a text or book read by the students or collective remembering where they discuss their past experiences and their past joint activities (Mercer 2003). Both Stahl (2004) and Mercer (2003) point out that in small-group interaction, as participants engage in the complex negotiations that make collaborative knowledge building possible, group meanings become intertwined, in subtle ways, with individual interpretive perspectives. These previous views imply that explorations of knowledge building should draw on and focus around the concepts used by learners themselves and the ways in which they cooperate to create a link between the concepts they use and the phenomenon they are studying and the nature of the resources that they employ to build shared knowledge in the given learning situation.

Earlier findings on learning and virtual interaction underline the need for further investigations of both the cognitive and social and the contextual socio-emotional features of grounding in CSCL environments (Arvaja 2005; Järvelä & Häkkinen 2002; Järvelä, Lehtinen & Salonen 2000). Oliver and Shaw (2003) assume that the problem involved in collaborative online learning lies in participants' degree of engagement in online work. In gener-

al, interactive communication technology and collaborative learning models have contributed to the range of socio-emotional interpretations that can arise in conjunction with computer-mediated learning processes (Järvelä et al. 2000).

3.4 Creating an Open and Constructive Atmosphere in Learning Groups

To find the adequate extent of common ground essential in collaborative activities (Dillenbourg 1999), participants must communicate with each other. For example, Wegerif (1998) observed that before collaborative learning can take place in a web-based learning environment, people must be able to feel that they can reveal their personal emotions, assumptions and knowledge freely without having to fear unfair treatment from their fellow participants. According to Wegerif, creating a sympathetic sense of community is a necessary first step in collaborative learning (see also Gunawardena 1995).

3.4.1 A Sense of Community

With a few notable exceptions, the social and emotional aspects of collaboration have attracted less attention than its cognitive features (Crook 2000). However, there are many studies arguing that a sense of community and an open and sensitive atmosphere are necessary preconditions of collaborative learning (Cutler 1995; De Jong et al. 2005; Rourke & Anderson 2002; Rovai 2000; Wegerif 1998; Wellman 1999). A sense of community is important especially in online learning environments, where learners are physically separated from each other and do not know one another. It is essential for the emergence of a mutual sense of interaction that learners feel their fellow learners' presence (Cutler 1995; Rovai 2000). A strong mood of group togetherness enhances the flow of information, the availability of support, commitment to group goals, and satisfaction with group efforts (Wellman 1999). When a sympathetic atmosphere prevails, learners are able to share their feelings, knowledge and beliefs more openly and engage in discourse that fosters learning. De Jong and his colleagues (2005) consider that in order to establish and maintain a secure and collaborative atmosphere, learners should give precise expression not only to ideas and knowledge but also to social and affective propositions.

McMillan (1996) describes membership as involving a sense of belonging, a sense of confidence about being a member and a sense of being accepted by a group, which fosters the sense of belonging (see also Oliver & Shaw 2003). Membership creates a feeling of safety that encourages learners to share, for example, personal information and intimate issues. A sense of community means four things: 1) a spirit of belonging together, 2) trust in a reputable authority embedded in the structure of the community, 3) an awareness that mutual

belief comes from being together and 4) a shared collective history. (McMillan 1996.) De Cremer, Snyder, and Dewitte (2001) argue that a strong perception of trust can have a positive effect on interaction. For example, a study by Johnson, Chanidprapa, Won Yoon, Berrett and La Fleur (2002) considers that a lack of any type of trust can make collaboration very difficult. Computer-mediated communication depends on trust between learners that reinforces their sense of community and enhances their contributions by enabling them to share their feelings, knowledge and beliefs and collaborate with each other. Before learners can enter into collaboration, they must be able to depend on each other, have a sense of warmth and belonging and feel close to one another. (Rourke & Anderson 2002; see also Kirschner & Kreijns 2005.)

Learners' feelings of belongingness and engagement may grow if they are, for example, greeted by their first names (Bonk, Wisner & Nigrelli 2004; Light, Nesbitt, Light & Burns 2000). Hara, Bonk and Angeli (2000) see social cues and signals, such as self-introduction, expression of feelings, greeting, closure, telling jokes, the use of symbolic icons and compliments, as necessary at the beginning of an online course, helping students to feel more comfortable with working together and building common ground. On the other hand, Walther (1996) asserts that communication is more effective when there are fewer socio-emotional signals and cues. The study by Hara and her colleagues (2000) supports this view. The students observed by them gradually reduced their reliance on social cues and signals as the online course progressed and when they had become highly focused on the course task and the ongoing discussion. However, the study found that at the beginning of the course the students made more use of social signals and cues and that it was later on that these cues became less frequent, indicating that the students first needed to create a sense of community. On the other hand, according to Walther and D'Addario (2001) the availability of a greater number of cues indicates and provides a greater sense of social presence.

A relaxing atmosphere may make learners more disposed to ask for support and information when they need them. Expressing one's appreciation and emotions is related to the development of a more positive ambience in online learning environments (Rourke & Anderson 2002). Stable group development and group cohesiveness seem to require, as an important precondition, the integration of differences, for example the integration of learners' needs and resources (McMillan 1996). Once the availability of support and a basis of understanding have been established, learners may share their feelings, such as criticisms, suggestions and different opinions (McMillan 1996). Lahti, Eteläpelto and Siitari (2004) found that conflicts emerging in small-group activities helped participants to develop their emotional and social competencies. Conflicts and solving them also heighten participants' awareness of the difficulties of collaboration, thus making them realise what a demanding enterprise it is to turn a group into an effective learning community and familiarising them with the problems that the allocation of tasks and responsibilities can give rise to. However,

conflicts that arise during collaborative activities can either prevent the growth of a sense of group identity or strengthen it. This might depend on how willing participants are to commit themselves or take responsibility for their group collaboration. Lahti and her colleagues (2004) go on to argue that an ideal learning community might be a place where individuals can access not only each other's intellectual resources as Mercer (2003) puts it, but also one another's emotional and social resources.

The problem facing online learning environments is finding ways of generating a sense of community in a situation where there are no nonverbal cues to help build strong interpersonal ties (see also Rovai 2000). This lack of nonverbal cues makes it difficult to set up a group where learners feel safe enough to envisage successful collaboration with each other, but if the group manages to find and maintain common ground, they might be simultaneously able to create such an atmosphere by using the mechanisms of common ground. Thus, McMillan (1996, p. 322) argues that "contact is essential for a sense of community to develop". This is more a matter of the quality of the contact than of the mere establishment of any kind of contact. He is saying that shared emotional connections in time and space are collective experiences that should become valuable events for a group, after which they can spur it further to reach its highest ideals. However that may be, these previous studies cover mainly face-to-face situations; what we also need are studies that look at the socio-emotional aspect of online learning environments.

3.4.2 Uncertainty

All initial interaction involves some degree of uncertainty (Berger & Bradac 1985; Berger & Calabrese 1975). Online learning environments, where participants are often physically distanced from each other, lack immediate feedback and nonverbal cues, which might further aggravate feelings of uncertainty and therefore their effect on participant interaction (e.g. Järvelä & Häkkinen 2002; Mäkitalo et al. 2003; Roschelle & Pea 1999). Discourses unfolding in online learning environments can be investigated with the help of the uncertainty reduction theory (Berger & Bradac 1985; Berger & Calabrese 1975). The theory suggests that a high degree of uncertainty may hinder group participants from effectively communicating with each other as a means of attaining shared goals (e.g. solving a problem together). Berger and his colleagues' uncertainty reduction theory, a contribution to communication science, seeks to explain how uncertainty affects communication. Originally their theory had no links with computer-supported collaborative learning. Its important components, applicable also to CSCL, are uncertainty, the amount of discourse, and information seeking. Berger and others show that as the amount of verbal communication going on in initial interaction situations increases, the level of uncertainty decreases. Furthermore, as uncertainty is reduced, the amount of verbal communication increases. They also

point out that information-seeking behaviour increases in uncertain situations. Again, as uncertainty is reduced information-seeking behaviour decreases (Berger & Bradac 1985; Berger & Calabrese 1975). Therefore, uncertainty may influence online discourse and online collaboration in a number of ways.

Uncertainty can appear at two different levels, socio-emotional and epistemic (Mäkitalo et al. 2003). At the socio-emotional level, uncertainty can emerge when, for example, there is no immediate feedback from other participants on how they are reacting to a participant's messages, on whether they agree or disagree with the participant's suggestions and how they will organise their joint work. At the epistemic (content) level, participants may be uncertain about how valuable their contributions are as to their content: Is their input relevant to the issue at hand? Do their learning partners understand the content of their messages? Because of the novelty and complexity of their social context, online collaborative learning courses can be regarded as a highly uncertain form of communication where learners may need additional support to reduce uncertainty. The uncertainty reduction theory emphasises the role of communication as an explanatory factor in a person's behaviour in social situations (Berger & Douglas 1981).

Uncertainty has been explored in, for example, social and environmental psychology (Budescu, Rapoport & Suleiman 1990; Gärling, Biel & Gustafsson 1998; Kramer 1999) and in clinical and health policy (Balsa, Seiler, McGuire & Bloche 2003; McCormick 2002). Budescu and his colleagues (1990), for example, examined asymmetric groups and how environmental uncertainty (referring to the size of a natural resource on which a group depended) affected individual and group requests and how it related to individuals' attitudes towards risk. Budescu and others found that environmental uncertainty and asymmetry affect requests by both individual group members and a group as an unit but also individuals' attitudes towards estimating risks. Balsa and her colleagues (2003), again, studied the clinical uncertainty involved in the doctor-patient encounter, discovering that there is racial and ethnic disparity in medical care. According to McCormick (2002), in nursing research a state of uncertainty has been considered a major component of all illness experience, affecting also patients' psychosocial adaptation and the outcomes of disease. Uncertainty is seen as a multidimensional concept which influences, for example, individual and group information seeking and estimation, individual and group decision-making, and the doctor-patient encounter. The description of uncertainty offered by Berger and his colleagues (Berger & Bradac 1985; Berger & Calabrese 1975) is, rather, situated in social interaction where the focus is on how an individual behaves and reacts in an uncertain interpersonal communication situation.

The uncertainty reduction theory serves as a theoretical framework for investigating communication in organisations during, for example, mergers, and for finding ways of reducing and managing uncertainty and increasing positive reactions (e.g. Kramer 1999;

Kramer, Dougherty & Pierce 2004). Tidwell and Walther (2002) have applied the theory to examine computer-mediated communication and the uncertainty reduction strategies drawn on in communication of this kind. They ascertained that the employment of direct uncertainty reduction strategies such as self-disclosure and questions leads to more effective discussions. Ramirez, Walther, Burgoon and Sunnafrank (2002) analysed the ways in which people engaged in communication mediated by computers and using the new media look for social information - information about other people - and into the factors that influence their selection of a strategy or strategies. According to Ramirez and others, information seeking is a goal-driven activity where information is pursued as a means of achieving social, instrumental and emotional aims or a combination thereof. The more important a goal is to the learner, the greater number of strategies they exploit to enhance interaction and collaboration with their fellow learners. This could be compared to the collaboration effort described by Koschmann and others (2005) and Mercer (2003) (see also Clark & Brennan 1991; Dillenbourg & Traum 1999), which drives learners to negotiate meanings and mobilise common knowledge when they need to produce a shared understanding of a task facing them. Ramirez and his colleagues (2002) conclude that more research is needed to compare the effects and effectiveness of different information-seeking strategies and to link them with broader factors by, for example, identifying those factors that influence a desire for well-reasoned information and ways of seeking information and so on. However, the relation between uncertainty and learning outcomes has not been investigated systematically. Interaction which fosters learning can be promoted in a variety of ways, for example through the different tools available in online learning environments.

3.5 Collaborative Scripts as Process-Oriented Scaffolds

The problem confronting the field of computer-supported collaborative learning is that online discussions may not be coherent as regards their subject matter (e.g. Hron, Hesse, Cress & Giovis 2000). According to Dillenbourg (2002), free collaboration does not necessarily lead to learning. Collaborative learning activities, such as knowledge articulation, explanation, argumentation and other demanding epistemic processes, can be supported in different ways with online communication tools and shared online workspaces (e.g. Häkkinen et al. 2004; Strijbos et al. 2004). A recent approach to the facilitation of online collaborative learning at the process level is providing learners with collaboration scripts that specify and sequence their collaborative learning activity and distribute the constituent actions among the learners (Dillenbourg 2002; Kollar, Fischer & Hesse 2003; Weinberger 2003). Collaboration scripts comprise a number of rules which prescribe the way in which learners should interact with each other and collaborate on a task (O'Donnell 1999). Specifying learners' collaboration processes through scripts is intended to help learners to enter

into activities that serve knowledge construction. Scripts which sequence collaborative activities should support productive interactions; for example, learners should be induced to engage in particular actions at particular times. Scripts are meant to assign actions in such a way that all learners will carry out, by turns, the action specified or perform a predefined series of specified actions. (Weinberger 2003.) Collaborative scripts have been found to promote collaborative learning activities in face-to-face learning environments, where learners are verbally instructed to complete certain actions at certain times (O'Donnell 1999). In the context of online collaborative learning, the script is conveyed through the design of the interface instead of verbal instructions and training. The interface specifies and sequences learner actions during the actual collaborative learning phase, for instance by prompting learners to answer particular questions (Weinberger 2003).

Characteristically, scripts provide collaborative learners with a complex set of instructions detailing several goal dimensions. The prototypical script of O'Donnell and Dansereau (1992), for instance, supports meta-cognitive and elaborative activities by collaborative learners. Their script, fostering text comprehension, asks learners to read paragraphs through, repeat them in their own words, mutually monitor these summaries for mistakes, and elaborate on the given text (O'Donnell & Dansereau 1992). Scripts may also be designed to support specific process dimensions of collaborative learning, for example to foster epistemic activities or social processes in particular. According to Weinberger (2003), social scripts supply predefined roles intended to promote better social processes. The purpose of an epistemic collaboration script, again, is to facilitate cognitive processes by offering collaborative learners a strategy for carrying out a task. Scripts of this kind may help learners to establish and maintain shared conceptions and look at a problem or task from multiple perspectives (Weinberger 2003).

On the one hand, epistemic scripts may enhance collaborative activities such as explaining (Coleman, 1998), questioning (e.g. Ge & Land 2002; Hron et al. 2000) and expert-like problem-solving behaviour (Dufresne, Gerace, Thibodeau Hardiman & Mestre 1992). Coleman (1998) explored explanation prompts supporting explanation activities and also roles relevant in a face-to-face collaborative learning situation. The roles and activities were distributed by using cards; for example, a reader and writer card instructs the learner to read the question on the card and document group-work activities while an explainer card assigns a learner the role of providing explanations to a question. The results of Coleman's study show that the prompts led the learners to construct more advanced explanations. Ge and Land (2002) were interested in the effects of question prompts on individual and collaborative learning in face-to-face situations. They found that question prompts enhanced collaboration in groups but also helped individual learners to represent and solve problems, justify their solutions to other learners, and monitor and evaluate learning processes. The study by Hron and others (2000) investigated dialogue structuring. It was discovered that

both implicit (key questions which focus on subject matter) and explicit (a series of rules which direct learners to discuss a learning task and work together to carry it through) structuring improved the learners' focus on the learning material and reduced off-task talk during online discussions. However, though dialogue structuring resulted in a more intensive exchange of questions and answers, indicating the learners' engagement in the online activities, there was no sign of improved knowledge acquisition.

On the other hand, epistemic scripts may disrupt epistemic activities if they are too detailed (Baker & Lund 1997; Dillenbourg 2002), if they underestimate expert learners' capabilities (Cohen 1994; Salomon & Globerson 1989) or if they overestimate novice learners' resources (Dansereau 1988). Scripts can interfere with spontaneous interactions and cognitive processes; for example, scripts intended to support specific activities cannot predict learner needs and change their structure automatically if it becomes necessary to adopt a new approach in order to construct knowledge. Learners may apply special knowledge construction strategies that a typical script does not recognise. (Weinberger 2003) Very detailed scripts can hinder rather than promote knowledge construction; for example, when learners are solving complex problems, scripts may prevent them from articulating multiple perspectives (Dansereau 1988). Learners may also be unable to benefit from collaborative scripts which focus on so many aspects of a situation that the learners can act out only parts of the script they were provided with; for example, a social collaboration script may direct learners to ask questions regardless of their quality and content (Weinberger 2003). (see also Dillenbourg 2002.) However, scripts can help to integrate both face-to-face and computer-mediated communication and individual and collective aspects of interaction, making them suitable for use in education. One of the major questions in this field concerns the extent to which interaction should be structured on an epistemic level so as to support learners as they operate in the uncertain field of online learning.

3.6 Valuable Discourse and Collaborative Activities in Learning Contexts

In collaborative learning environments, certain forms of discourse are considered important for learning. According to Scardamalia and Bereiter (1994), simple discussion might not be successful in achieving group sense-making. Discourse where participants ask certain types of question, evaluate suggestions, elaborate explanations and justifications, hypothesise and sum up the ongoing discourse seems to be an especially effective way of promoting learning in collaborative situations (e.g. Fischer, Bruhn, Gräsel & Mandl 2002; King 1999; Scardamalia & Bereiter 1994; Webb 1989). Asking questions as such does not necessarily foster collaborative learning, but it can be seen as mediating learning, for example by enhancing learners' comprehension and knowledge construction (King 1999). According

to King (1999), open-ended and thought-provoking questions improve the quality of discourse because they stir participants to work out explanations and offer reasons. Giving and receiving explanations seem to be more beneficial to achievement than giving and receiving information alone or receiving no help at all (Webb 1989). King (1999) points out that comprehension questions are not particularly stimulating because they are memory-based and ask learners only to recall the material referred to. Answering comprehension questions requires a responder to reformulate definitions and descriptions by paraphrasing them in their own words, which enhances their own thinking and learning. The seeker of the information thus provided, again, learns when they receive the relevant help and understand it and have an opportunity to themselves elaborate the information further (Webb 1989). Such a discourse pattern of information seeking, responding to information seeking, and getting the requested information is seen as an important process in collaborative learning (King 1999; Webb 1989).

Apart from discussing types of discourse which are important in collaboration, Barron (2000) identifies also different activities which learners should join. Successful collaborative activities have three distinct interactional dimensions reflecting the nature of shared understanding within collaborating groups (Barron 2000). Firstly, in successful collaborative activities learners engage in and focus on performing a joint task and building knowledge together (the degree of mutuality in the interaction). When the group interacts, the learners refer to each other's ideas, elaborate them and solve problems and perform tasks together. In unsuccessful collaborative activities learners tend to work individually despite belonging to the same group. Secondly, successful collaborative activities give every learner an equal opportunity to participate in knowledge construction (a shared task alignment). In other words, group members listen to each other's ideas and acknowledge them by taking them in and developing them further. Ideas are not turned down without negotiation and reasoned argument. The rejection of proposals and ideas can lead to conflict, but in successful collaboration learners will discuss any disagreement that might arise and resolve it together. Thirdly, during the critical phases of group interaction learners' attention should focus on the learning assignment (joint focus of attention). In some situations learners can divide the tasks entailed by the assignment; for example, one of them might write down the shared ideas formulated by other group members. However, the main principle is that every group member takes part in and focuses on the assignment to be performed by the group. (Barron 2000.) According to Barron (2003), collaboration involves a dual-problem space where learners must engage in and develop a content space and a relational space. The content space operationalises the learners' need to concentrate on solving a problem, for example by tracking and evaluating their own and other group members' epistemic processes. The relational space covers the interactional challenges and opportunities that go with this, for example how a learner reacts and responds to their fellow learners' ideas and sugges-

tions and how their fellow learners, in turn, respond to the learner's own ideas and suggestions.

Mercer (2003) points out that learners should respond to each other's ideas by offering constructive criticism and relevant information to serve as a basis for joint deliberation. In exploratory talk, which Mercer describes as a promoter of joint critical problem-solving, learners should challenge each other's proposals and issue counter-challenges and give reasons for their views and suggest alternatives to their fellow learners' ideas. In this process, learners should reach a joint agreement. They should also discover new and better ways of jointly making sense. As Barron (2003) sees it, more successful groups discuss and accept valid proposals, whereas less successful groups ignore and reject them. In other words, more successful groups seem to reach the joint agreement suggested by Mercer (2003). Sometimes it might be important for a group to concentrate on off-task activities so as to engage its members' attention or build a sense of community. It is therefore crucial, when investigating the processes going on within a learner group, to attend to both the content space and the relational space, both the cognitive and the socio-emotional levels of group interaction.

3.7 Analysing Interaction and Learning

It is important, when starting an examination of collaborative learning through computer-mediated conversations, to first answer a number of fundamental questions. For instance, what is the analytic unit? How will the researcher approach and consider online interaction and collaborative activities, and what, from the viewpoint of the particular study about to begin, are the essential features of online conversations? (See Reed, Schallert, Benton, Dodson, Lissi & Amador 1998.) According to Stribos and his colleagues (2005), the analytic units used in the research area of computer-supported collaborative learning have been defined in a variety of ways, which makes it difficult to compare different studies and the analyses made and results gained in interrelated research. Therefore, the focus here is on giving some idea of what are the methodological strategies employed when studying interaction and learning in collaborative situations.

Interaction and collaborative activities generated in computer-supported collaborative learning have been scrutinised both quantitatively and qualitatively. In the quantitative approaches, learner participation has been measured by the number of messages sent by group members (Harasim 1993) and by the length of discussion threads (Hewitt 2003) and through social network analysis (Lipponen 2000). Single messages have also been looked at by evaluating the cognitive quality of their discourse (e.g. Hakkarainen, Lipponen & Järvelä 2002; Hara et al. 2000). However, a high number of messages and a high cognitive quality of individual messages do not yet guarantee that learners commit themselves to and

are successful in building knowledge together. We need new qualitative methods for analysing the shared processes and understanding that arise in computer-mediated interaction (e.g. Hara et al. 2000; Hmelo-Silver 2003; Hoadley 2000; Häkkinen, Järvelä & Mäkitalo 2003), not to mention a suitable theoretical framework to underpin explorations of interaction and collaborative activities in online learning environments.

Given the complexity and richness of online interaction and learning, qualitative content analysis might be able to tackle its different elements better than quantitative approaches (Gerbic & Stacey 2005). Content analysis is a general term describing a variety of textual analysis methods for comparing, contrasting and categorising data (Schwandt 2001; Silverman 1994). Content analysis can be quantitative or qualitative (Silverman 1994). Silverman (1994) traces its roots to the field of communication; it is originally a quantitative method, but has been used also in qualitative research (see Arvaja et al. 2003; Garrison et al. 2001; Hara et al. 2000; Henri 1991). According to Gerbic and Stacey (2005), content analysis has been purposefully developed to serve or help to best reach the objectives of the kind of studies where it is employed. Hmelo-Silver (2003) considers that a variety of methods is necessary in research on collaborative activities as a means of avoiding the risk of being overly reductionistic. Thus, there are some studies that use both quantitative and qualitative approaches to examine computer-supported collaborative learning (e.g. Ahern, Peck & Laycock 1992; Hmelo-Silver 2003), where the main focus is on analysing the social and cognitive processes involved in it.

Clark and his colleagues (Clark & Brennan 1991; Clark & Schaefer 1989) concentrate on investigating common ground at the linguistic level in face-to-face conversations. There are studies that explore interaction, especially common ground, in face-to-face learning situations (e.g. Jeong & Chi 1997; Stahl 2002) and in online learning situations (e.g. Beers et al. 2005; Dillenbourg & Traum 1999; Pfister 2005; Van Der Pol et al. 2003). For example, Van Der Pol and others (2003) put grounding to use as an analytic tool, considering it from the perspective of the connections between messages, explanations and references. Thus, most of this research is concerned mainly with the cognitive level of grounding, with how learners reach shared understanding of concepts and phenomena. There are also studies of collaborative learning that look at a certain type of activity, problem-solving, where the learning task is usually well-defined (e.g. Baker et al. 1999; Barron 2003; Beers et al. 2005; Fischer et al. 2002; Jeong & Chi 1997; Mulder 2004; Roschelle & Teasley 1995; Stahl 2002; Weinberger 2003). Research on interaction and learning as a part of activities centred around ill-defined tasks is less common.

As Fischer and his colleagues (2002) observe, much of the research conducted in this field focuses on learners' collaborative processing of content, not on how much learners talk about the content they process (see also Hmelo-Silver 2003). Fischer and others measured the quality and breadth of individual knowledge construction, according to them a

rare procedure in studies of computer-supported collaborative learning. They based their analysis on well-defined tasks, which made the measurement and comparison of learning outcomes feasible. By contrast, problems arise when evaluating learning outcomes from open-ended problems or tasks, where the content of discussion is not predictable in advance. Further, instructional design approaches vary. Individuals and groups can themselves plan the tasks they are to perform or the problems they are to solve. This makes valid comparison between individual and group learning outcomes impossible because of the diversity of their tasks and learning goals. On the other hand, individual tests may not reveal what a group learns (Stahl 2005). Group learning can also be seen as something that exceeds what an individual is able to achieve and repeat on their own. How, then, can such learning be measured? As Koschmann (1994) and Scardamalia and Bereiter (1994) see it, the nature of group dynamics makes intensive discussion necessary before group sense-making can be achieved.

It seems that learning in collaborative learning situations cannot be explained as the result only of specific abilities; instead, it emerges as the product of complex and dynamic interactions between cognitive, social, affective and motivational variables (see Pintrich, Marx & Boyle 1993). We need a better understanding of how individuals' mental processes relate to the social, emotional and situational features that influence cognitive performance and learning in learning groups. Among the challenges that this raises is developing a range of both quantitative and qualitative methods suitable for examining interaction and learning as they are affected by these different factors operating in online learning environments. Koschmann and his colleagues (2005) argue that if learning is supposed to happen in joint interaction, then learning and interaction should be made available within the same discourse. However, research which foregrounds a group as an analytic unit and looks at the collaborative group process as it unfolds from the beginning to the end of an online learning course as a whole is less common. In studies of the relationship between learning and learners' joint interaction, the felt quality of the learners' experience of collaborative activities should be analysed more carefully (Crook 2000; see also Häkkinen et al. 2003). Learners' individual perceptions of collaboration may affect the collaborative endeavour which drives their engagement in the joint activity.

4

Aims of the Study

This study can be seen as basic research on the mechanisms of establishing and maintaining common ground, considered as methods which may improve learners' joint focus on their collaborative activities and, therefore, enhance the quality of learner interaction in the higher education context. At the same time, the aim was to investigate how scripting influences learner interaction and learning processes in collaborative learning situations in higher education and how learners operating in such contexts design joint goals and build knowledge that leads to shared understanding and knowledge. The purposes of this study were threefold:

1. to increase our knowledge of online interaction and learning by exploring
 - the mechanisms of establishing and maintaining common ground (especially Substudies I, II, III),
 - the processes of building shared understanding in collaborative learning situations (Substudy IV),
 - the effects of scripts on interaction in collaborative learning (Substudy V);
2. to develop methods for analysing online interaction and learning (Substudies I-V);
3. to develop pedagogical models to explain and foster the process of learner collaboration (Substudies I-V).

Substudy I searches for new approaches to finding out how students establish and maintain common ground in interaction, particularly in situations where they are working collaboratively in an online environment. The aim of Substudy II was to determine the nature of the feedback that learners used as a means of building common ground and deepening interaction in a case-based online discussion. Substudy III examined the mechanisms of

creating and sustaining common ground brought into play when interacting through online conferencing; it provides empirical evidence of the mechanisms of common ground required in collaborative online activities. Substudy IV looked at how learners operating in a small group reached shared understanding as they worked out joint research questions and built a theoretical framework. This substudy also sought to identify the resources and tools that the learners employed in the process. The learners' own interpretations of their group activities and learning were also taken into account. The focus of Substudy V was on an investigation of the effects of an epistemic collaboration script on the amount of discourse and information-seeking activity generated during and the quality of the learning outcomes gained through scripted as compared to unscripted collaborative learning. A further aim was to consider the ways in which learners seek and receive information and the nature of the information thus sought and received and analyse their learning partners' responses to information exchanges of this kind.

5

Methods

The studies were carried out in higher education settings in Finland, the USA, Great Britain and Germany in 2000-2002. The data of Substudies I-IV were collected as a part of the SHAPE project (Sharing and Constructing Perspectives in Virtual Environments) based in the Universities of Oulu and Jyväskylä, Finland. The aim was to explore the mechanisms of establishing and maintaining common ground and building shared understanding as they are employed in collaborative activities. Substudy V was conducted at the Ludwig Maximilian University in Munich, Germany. During the researcher's one-year research visit in Tübingen, Germany the data were analysed for information on the effects of scripting on uncertainty, interaction and learning.

5.1 Subjects and Research Design

The subjects of the first two substudies (I and II) were from the same project (SHAPE 2000). In Substudy I they were pre-service teachers attending the University of Indiana, USA (n=67), the University of Warwick, Great Britain (n=9) and the Universities of Jyväskylä (n=19) and Oulu (n=21), Finland. The total number of students was 116. The subjects of Substudy II were pre-service teachers at the University of Indiana (n=35), USA and the Universities of Jyväskylä (n=12) and Oulu (n=21), Finland, totalling 68 pre-service student teachers. Of the university teachers taking part in the study as mentors one was from the University of Indiana while two were from the University of Jyväskylä and four from the University of Oulu. Participation in the online course was credited as a component of the optional courses included in the teacher education programmes that the students were on. All the students had already completed a part of their teaching practice and had basic knowledge of computers and the Internet. During the two-month project the students communi-

cated with each other using an asynchronous online learning environment, ProTo. The main topics of the online discussions were related to teaching and learning. The students constructed case-based descriptions of areas such as learning contexts, technology in education, and teachers' professional growth. Their learning task was to keep their personal case discussion going and sum it up halfway through and at the end of the online learning course. The students were required to visit the ProTo environment at least once a week.

Substudies III and IV were a part of the second stage of the SHAPE project (2002) where the subjects comprise a small group of pre-service English teachers participating in a course at the Universities of Jyväskylä (n=2) and Oulu (n=1). A team of three pre-service teachers were selected for investigation from among six groups because the members of this particular group worked mainly online. All three students had basic knowledge of computers and the Internet. The two students from Jyväskylä knew each other, while the student from the University of Oulu knew neither of the other two beforehand. The task set for the students on the online course was to establish joint research topics in the area of culture and communication and form subgroups to work together in a shared research project. First, each class met locally in Oulu and Jyväskylä, where the students were introduced to the course content and timetable and to the Discendum Optima online learning environment. Second, the students discussed the main themes of the course in study circles that came together in the online learning environment. After the study circles they formed subgroups and began working on their research topics. At the end of the course, each group presented their accomplishments in a videoconference meeting linking Oulu and Jyväskylä. Like the subjects in Substudies I-II, they were required to visit the online learning environment at least once a week during the two-month project.

The subjects of Substudy V were 48 first-semester education students at the Ludwig Maximilian University in Munich attending an introductory course. They were randomly organised into groups of three students (n=16), and each triad was randomly assigned to one of the two experimental conditions. The first condition was based on an epistemic script while the second condition was unscripted. In both conditions the students had the same length of time to complete the task. In order to preserve anonymity, the participants were drawn from three different seminars and were given code names during the learning session. The students were placed in three separate rooms, communicating with each other over the online learning environment. They collaborated on the application of the theoretical concepts of attribution theory (Weiner 1985) to three problems presented to them in the online environment. These three authentic cases were the central elements in the online learning environment. The students analysed and discussed the problems using online discussion boards within the groups of three students. The online environment had three online discussion boards, one for each problem. In each condition, the collaborative learning session lasted 80 minutes. In the unscripted condition the students were given no sup-

port to solve the three cases. In the epistemic script condition, prompts guided the participants to draw on theoretical concepts to consider the problems. The prompts were meant to help the participants to identify the relevant problem information and exploit the concepts of attribution theory to make sense of the information. It included questions and proposals for pedagogical interventions into the problem. The settings of the experiment created a context that was different from that of the other substudies. The students were online simultaneously, but their interaction was still termed asynchronous communication because of the discussion tool they employed. The collaborative sessions lasted 80 minutes, the courses in the other studies two months. The task and the authentic cases were designed by the researchers as against the other two study conditions, where the students themselves created their own research problem(s) or cases which they were supposed to solve together.

The substudies were based on a variety of research designs and approaches. In Substudies I-IV, the online course lasted two months and the students accessed the online environment at different times and were spatially separated. These first four substudies were carried out in an authentic teacher education context. A different research design and approach was adopted in Substudy V, which was implemented in a controlled experimental setting. In it, the students took part in the 80-minute online session simultaneously in three different rooms in the same building. They discussed their learning task over an asynchronous communication forum, but they were informed in advance that there were two other students online at the same time with whom they were supposed to communicate and collaborate. However, all five studies were conducted in online learning environments established in a higher education context.

5.2 Online Learning Environments

In Sub-studies I and II, the students communicated with each other using an asynchronous web-based learning environment, ProTo. ProTo was designed at the Research Unit for Educational Technology, University of Oulu. It included an asynchronous discussion tool where discussions formed a threaded structure (described in more detail in Pulkkinen and Peltonen 2000).

Substudies III and IV employed the Discendum Optima web-based learning environment. In this shared workspace the students could find all the course information, take part in discussions about the main course themes during the study circle phase, and work in subgroups. When the subgroups had been set up, an empty file was created for each group. The groups were instructed to construct a first page presenting the group members' and the group's research questions. Otherwise the groups were free to create and add different objects, such as discussion forums, Word and HTML documents, tables, photos and so on. In

the learning environment, communication was mainly asynchronous, but a chat tool made synchronous communication also possible.

In Substudy V, the learning environment, built on standard HTML-format web pages, is accessible also over the World Wide Web (WWW). It is a password-protected web site on which three learners can post messages. The screen presents learners with a task description and a timer, which can be modified and adapted to different settings of the learning environment. There is a map of the three discussion boards, which should make orientation easier. The current discussion board is marked with a red X. The screen has also a description of the problem cases. Below each case information window there are text windows where a text message can be typed. In the epistemic script condition the text windows presenting the initial messages are pre-structured with prompts, to which the learners are supposed to react. After the learners have sent in their contributions they can access an overview page of the individual online discussion boards. As is typical of standard discussion boards, the overview page shows each discussion as a threaded structure.

5.3 Data Sources and Analytical Framework

In these five substudies, a variety of methods was employed to analyse mainly the discussion data, but also the different documents produced by the learning groups and the learning outcome data. A combination of quantitative and qualitative methods was applied in Substudies I, II and V. The aim was to provide richer detail by combining a quantitative and a qualitative analysis (Miles & Huberman 1994). In Substudies III and IV, which explored small-group activities, qualitative content analysis methods were more suitable given the aim of producing in-depth material and naturally occurring data (see Chi 1997; Silverman 1994). In these substudies we designed a framework shaped by the research objectives and the complexity of online interaction and learning, leading us to content analysis. To gain reliable information on learning and interaction it is important to develop valid research methods that match the intricate phenomenon consisting of mechanisms of establishing and maintaining common ground, the construction of social knowledge and scripting in a computer-supported learning environment. In the data analysis, different approaches were also exploited, such as theory-driven and data-driven ones. The data-driven approaches were intended to generate more detailed information from a smaller sample without ignoring the richness and complexity of the online learning process. This makes possible an enhanced understanding of episodes and situations, but at the same time it reduces the scope for generalising the results (see Patton 1990).

Substudy I analysed the participation patterns of the students and mentors, such as the number of students who never logged on to the online learning environment, the number of students who did log on but left no messages, the number of visits to the online learning

environment, and the number of messages sent. The discussion data were examined qualitatively by using two different methods. The first method, which was applied here partially, is based on Järvelä and Häkkinen's (2002) model of analysing the type of messages sent during and the level of discussions carried out in online learning environments. The second analysis focused on the nature of the feedback that the learners gave to each other: did they show interest in one another's opinions and experiences and were they willing to respond to their fellow learners' messages (Baker et al. 1999; Brennan 1998)?

Substudy II developed further the analysis carried out in Substudy I. When scrutinising a discussion, a chart was first made that functioned as a research tool for exploring its path and content. Initially the chart displayed the location from which a message had been posted, information about the sender, the date of posting, and the references to other postings that the message contained. The charts were reformulated during later analyses. The next step was to identify the levels of the discussion. The different types of posting were examined and classified into the following categories: comment, suggestion, experience, new point/question, and theory (Järvelä & Häkkinen 2002). Drawing on the previous analysis, each discussion was grouped further into two different categories, progressive-level and deeper-level discussions. The last step was to look at the nature of the feedback the learners gave to each other and the nature of the questions that they asked as they sought to establish and maintain common ground during online conferencing.

In Substudy III the data were analysed with qualitative methods to identify the mechanisms of common ground used by the learners. The grounding mechanisms were derived from previous studies of grounding processes and led the analytic process (e.g. Allwood et al. 1991; Baker et al. 1999; Brennan 1998; Clark & Brennan 1991; Clark & Schaefer 1989; Dillenbourg & Traum 1999). The aim of this substudy was to offer empirical evidence of the mechanisms of common ground needed in collaborative online activities, not investigated in this way in earlier research. Therefore, the approach was partly theory-driven and partly data-driven, with the theory-driven element providing the items on which the analytic framework was based and the data-driven approach providing the content for these items. For example, the presence of another is one of the mechanisms of common ground derived from previous research, but the particular ways in which learners can, in text-based communication, show that they are aware of each other's presence or demonstrate their own presence to their fellow learners were identified in the substudy.

Substudy IV applied qualitative content analysis to capture the dynamic interplay between learners engaged in the collaborative construction of shared understanding and in knowledge building, and to pinpoint the resources and tools employed by them. Making sense of collaboratively built shared understanding and knowledge building presupposed making sense of student discussion and the nature and uses of the tools and resources which mediate student interaction and learning. A group focus made it possible to describe inter-

actions in a way that described, in a given discourse, the dynamic interplay in meaning making over time going on between the participants, the participants' understandings, the resources and tools they brought into play, the types of contribution they made, and their fellow participants' response or lack of response (see Barron 2003; Mercer 2003; Stahl 2002). According to Koschmann and colleagues (2005), collaborative learning should take place in joint interaction; therefore, the data analysis concentrated on the discussion between the learners and on how they cooperated to build shared understanding and knowledge.

Substudy V was based on quantitative and qualitative analyses exploring the effects of an epistemic script on the amount of discourse, and information seeking generated and the quality of individual learning outcomes achieved in an online collaborative learning process. The results on the individual learning outcome data were a part of an earlier overview paper (Weinberger et al. 2005). However, all the process-related data and their qualitative and quantitative analyses are original findings not published in the overview by Weinberger and others. In the quantitative analysis, word counts of all messages sent within each group were used as a measurement of the volume of group discourse. Information seeking was examined with the help of the social mode of co-construction dimension of a coding system for a multi-level analysis of knowledge co-construction (Weinberger, Fischer & Mandl 2002). Next, six central relations between the relevant theoretical concepts and case information were identified for the purposes of the students' post-test analyses. The qualitative approach exploited the method of case-based analysis. In other words, the first research results guided the selection of the exemplar cases after an in-depth content analysis (see Stake 2000). The findings of the quantitative analysis provided a view of the data that summarised the cognitive and social processes underpinning the learners' collaborative activities, but however fine-grained the analysis, its result failed to capture the rich variety of the interaction and collaborative activities in which the students placed in this particular situation engaged within their individual collaborative groups (see Hmelo-Silver 2003).

The analyses conducted in these substudies varied and involved many levels and sources: the individual level, extending from, for example, a single word to a sentence in an individual message; the interrelationships between two or more messages; the level of the overall discussion; or the level of the collaborative learning process and activities as a whole. The aim was to find good methods for exploring a phenomenon as complex as interaction and learning in online collaborative learning environments.

It was an advantage to this researcher to work as a member of a research group because support was available from fellow researchers familiar with the research data and available for discussions about the problems of the data analysis, helping to solve them. Thus, while analysing the data used in the substudies included in this dissertation was the responsibility mainly of the first author, the results were verified collaboratively, enhancing the validity

and reliability of the individual studies (see Miles & Huberman 1994). Especially in qualitative research, validity depends in important ways on the explanations offered being credible and the findings gained making sense (Janesick 2000). This aspect of the studies has been checked together with fellow researchers. Thus, it should be remembered that the accounts of interaction and learning in online collaborative learning environments presented here are the researcher's interpretations and that other interpretations can also be found (Janesick 2000). Check-coding is a good test of reliability (Miles & Huberman 1994), here used to assess the quantitative analysis (Substudy V). As regards the qualitative data analysis, where the coding, because of the complexity of the phenomenon looked at, lacked a clear focus on a particular unit (a single word, a sentence), agreement with fellow researchers was reached by discussing the match between the research aims, the data sources and the findings. A concise overview of the subjects, research topics and data collection and analysis procedures of the different substudies is presented in Table 1.

Table 1. *An overview of the methodological design of the five substudies of the dissertation*

Substudy	Subjects	Research topic	Data source	Data analysis
<i>Substudy I</i>	Pre-service teachers (n=116) & mentors (n=7) (representing four different universities in the USA, Great Britain, and Finland)	Analysing online interaction and learning	Written discussion data	Quantitative (participation) analysis & qualitative content analysis
<i>Substudy II</i>	Pre-service teachers (n=67) & mentors (n=7) (representing three different universities in the USA and Finland)	Online interaction; feedback and questions generated at different levels of discourse	Written discussion data	Quantitative & qualitative content analysis



Methods

<i>Substudy III</i>	Pre-service English teachers (n=3) (the Universities of Jyväskylä and Oulu, Finland)	Online interaction; mechanisms of establishing and maintaining common ground	Written discussion data, a joint project log, personal notebooks	Qualitative content analysis
<i>Substudy IV</i>	-"	Online interaction and other activities, shared understanding, the tools and resources used, learning experiences	Written discussion data, documents produced by the group studied	Qualitative content analysis
<i>Substudy V</i>	University students (n=48) (Munich, Germany)	Online interaction, uncertainty, collaborative scripts, learning	Written discussion data, post-test data	Quantitative analysis & qualitative content analysis

6

An Overview of the Empirical Studies

6.1 Substudy I

Mäkitalo, K., Salo, P., Häkkinen, P. & Järvelä, S. 2001. Analysing the mechanisms of common ground in collaborative web-based interaction. In P. Dillenbourg, A. Eurelings & K. Hakkarainen (Eds.), *European perspectives on computer-supported collaborative learning. Proceedings of the First European Conference on Computer-Supported Collaborative Learning*. Maastricht, The Netherlands: University of Maastricht, 445–453.

The ideas presented in this study are challenged particularly by certain critical questions concerning web-based interaction and the qualitative analysis of such interaction and related learning. The question arises whether students from different contexts and countries are able to achieve interaction of a standard that would stimulate educationally relevant higher-level online discussion and learning. Furthermore, as this field of research is quite new, there is a shortage of established methodologies for analysing computer-mediated communication and the complex phenomena it encompasses. The study was an attempt to find new approaches to discovering how people, particularly students working collaboratively in an online environment, establish and maintain common ground in interaction. The subjects of the study were pre-service teachers from the University of Indiana, USA (n=67), the University of Warwick, Great Britain (n=9), and the Universities of Jyväskylä (n=19) and Oulu (n=21), Finland, totalling 116 university students and 7 mentors. The log file data were subjected to quantitative, the discussion data to qualitative analysis.

The results show that learners acquire knowledge and patterns of reasoning from one another by sharing and negotiating knowledge and understanding. It is not obvious, how-

ever, that online interaction guarantees deeper-level insight. Shared understanding and knowledge construction call for effective interaction between learners; if their discussion consists of monologues instead of a dialogue, the participants have probably missed the opportunity to negotiate with each other for mutual benefit. Attaining a high level of interaction is a common problem in computer-supported communication, diluting the quality of CSC-based learning (e.g. Järvelä & Häkkinen 2002). Therefore, there is a need to identify the problems and potentials that arise when online learning environments are used to reconstruct learning and teaching methods and create innovative and highly motivating virtual environments. The substudy proves that examining web-based interaction by depending solely on quantitative analyses of participation rates does not capture what is actually happening and how learners learn in online interaction. Therefore, multi-methodological approaches are required.

6.2 Substudy II

Mäkitalo, K., Häkkinen, P., Leinonen, P. & Järvelä, S. 2002. Mechanisms of common ground in case-based web discussions in teacher education. *Internet and Higher Education* 5 (3), 247–265.

In this second study, the purpose was to explore how participants in a web discussion establish and maintain common ground as a means of achieving deeper-level interaction in case-based online discussions. The subjects in this study consisted of 68 pre-service teachers and 7 mentors from 3 universities (n=75) who were taking an 8-week online conferencing course. The written discussion data were analysed with a combination of quantitative and qualitative methods.

The results suggest that in order to establish common ground, it is essential that discussion participants, especially as fellow learners, not only offer written feedback to show evidence of their understanding of each other but also provide support to their peers in their replies to them. Asking questions is another way of signalling one's willingness to continue the discussion, essential for maintaining common ground. The findings reveal that as regards giving feedback and asking questions, the learners displayed different interaction patterns at different levels of discussion. In comparison to progressive-level discourse, deeper-level discussions were characterised especially by a greater amount of direct peer support through verbal feedback among the students. The mentors gave feedback based on agreement, notification and comparison more often in deeper-level discussions than in progressive-level discourse.

The interesting point is that in progressive-level discussions, the students made more use of agreement feedback than in deeper-level discussions. This might have hampered

progress to a higher level of discourse. If there is a great deal of agreement feedback, this may leave no space for the elaboration of and negotiation for meanings (see Dillenbourg 1999), which might be the end of the discussion. It is also possible that the students avoided the risk of undermining intragroup harmony. On the other hand, the mentors employed agreement feedback more often in deeper-level discussions, but it was perhaps intended mainly as support. Agreement can be a sign that shared understanding has been reached, but it can be also an indication of a lack of constructive criticism, seen as a demanding cognitive activity (e.g. Mercer 2003).

Supporting feedback was more common in deeper-level discussions. Previous studies suggest that positive feedback encourages learners to contribute to discussion and reinforces trust and a sense of sympathy within a group (e.g. Hara et al. 2000; McMillan 1996; Wegerif 1998). These findings seem to imply that offering each other feedback also when there were no obvious problems might have given the learners a better understanding of one another's points of view, enabling them to interact more effectively in the online learning environment. The learners also showed themselves willing to respond to the intellectually more challenging questions that emerged in the deeper-level discussions (e.g. King 1999; Webb 1989). Further research in this field should focus on examining what other mechanisms are used in small groups operating in online learning environments; more specifically, the emphasis should be on observing the progress of whole discussions and the ways in which small groups build shared understanding and knowledge in their course.

6.3 Substudy III

Mäkitalo, K., Pöysä, J., Järvelä, S. & Häkkinen, P. 2005. Mechanisms of grounding processes in online conferences: A case study in teacher education. In R. Nata (Ed.), *Issues in higher education*. New York: Nova Science, 115–146.

The aim of Substudy III was an empirical exploration of the role of the grounding process in interaction in an online learning environment. It is a case study of a single group consisting of three pre-service language teachers. The data included discussions, a project log, and personal notebooks kept by the three group members and were analysed with qualitative methods in order to identify the mechanisms of common ground present in the group discussion. In this case, where only some of the group members knew each other and the learning context and the learning task were new to them, the costs of non-grounding were potentially high.

The results show that there are several intertwined mechanisms exerting influence on the establishment and maintenance of common ground in collaborative online conferencing. The group members brought into play techniques of different kinds to build and

sustain their common ground. For example, as regards the presence of another, they frequently announced their presence by posting a message to the discussion list and also by informing each other when they were available and what they were doing. A learner might also indicate her expectations concerning the other participants' presence by asking a missing member direct questions in the hope that she would respond. This suggests that the presence of another enhanced the other participants' commitment to their joint online interaction. The problem is that because of the social distance involved in online learning environments, there is little sense of obligation about accessing them.

Writing a message to the discussion forum was a demanding task because the learners had to think, simultaneously, what they wanted to say and what was the best way to say it. The data analysis reveals that because there was no immediate feedback, the learners felt uncertain about how the other learners were reacting to their messages. As regards the processes of diagnosis, the participants were, among other things, asking each other directly whether the others understood what the sender of a message was trying to say. In this way they left room for negotiation and verification. Humour and emoticons served to prevent ideas and thoughts from being expressed in ways that other learners might have found too forceful.

Feedback plays a significant role in building common ground because it shows how other participants in an online discussion are reacting to a participant's message. Learners should be able both to seek evidence of each other's understanding and provide evidence of their own understanding. Learners need to display their attitudinal, behavioural reactions and understandings through some form of feedback. For example, the learners in the group studied here demonstrated their interest in continued interaction in different ways: by asking questions, by informing one another when they would access the online environment and so on. A variety of factors may affect learners' ability and willingness to establish contact with other learners. The topic of a discussion can either strengthen or weaken participants' enthusiasm, and there may also be participants capable of inspiring their fellow learners to continue to interact. In collaborative activities, it can be important to understand not only other participants' ideas, thoughts and perspectives but also their intentions and feelings. These findings indicate that grounding processes involve also a socio-emotional dimension (a relational space; Barron 2003), not only a cognitive dimension (a content space; Barron 2003).

If learners find the benefits of grounding minor, this may affect their use of grounding mechanisms. On the other hand, if they value its fruits, this makes them very willing to continue their interaction and persuades them to join together as a team. It may be that when the three pre-service English teachers collaborated on designing a set of joint goals, it made them keen to keep in touch and go on with their cooperation on completing their learning task. It is obvious that learners operating in an online setting may have to be more

careful about how they express themselves because the context has none of the immediate feedback and nonverbal cues that are available in a face-to-face situation. The learners in the group studied created their successful interaction patterns on their own, which also shows that mechanisms of this kind may be familiar to online learners from face-to-face situations and that the subjects transformed and adapted them to serve the requirements of a new environment. The findings reveal a need for further studies to improve our grasp of the role of grounding in online collaborative activities, for example at the content level where learners build shared understanding and knowledge.

6.4 Substudy IV

Mäkitalo, K. 2005. *From multiple perspectives to shared understanding: A small group in an online learning environment*. Manuscript submitted for publication.

Previous research indicates that the creation of a site for joint activity does not necessarily lead to success and that social interaction between learners may remain at a superficial level. The aim of Substudy IV was to investigate how a small group of learners reach shared understanding as they work out joint research questions and build a theoretical framework, and to identify the resources and tools they employ in the process. The study explored also the learners' experiences of collaborative learning and the links between the interactional processes these involved and such outcomes as the quality of the eventual group product. The data, consisting of the discussions that took place within and the documents produced by the group of three pre-service English teachers, underwent qualitative content analysis.

The group members used a variety of resources and tools to exchange individual perspectives and achieve shared understanding. The results suggest that discussions about joint goals and activities were an essential aspect of the collaborative learning situation. The group members reached a shared understanding of a set of joint research questions through a demanding negotiation process which took much time and effort at the beginning of the course. As they worked towards a decision about their research questions, the learners employed a variety of tools such as the online learning environment's chat and net meeting functions and various resources such as documents setting out individual perspectives. The learners' own interests, backgrounds and contexts affected the way in which they shared their individual perspectives and operated as a group within the online learning environment.

The group built knowledge through a cyclical process (see Stahl 2004). The individual learners' shared knowledge became the group's tacit knowledge, reprocessed to build new understanding. A comparison of the outcome of the group's activity (their final written assignment, called by the group their Final Work) with the group processes show that build-

ing their shared understanding and knowledge absorbed them throughout the course. There was a connection between the different activities, for example between the documents prepared by the learners and the discussions they had. The results indicate that during their discussions about their theoretical framework the group members were constantly reflecting on their joint activities. In fact, it seemed that they integrated their theoretical knowledge into their joint activity. On the other hand, the learners' reflection on their learning experiences reveals that they learnt more through participation in their joint activities than through building their theoretical framework as a group. It might be that because of these two processes - mastering the content and engaging in the activities entailed by it - were so closely related that the learners may not yet realise the value of the theories they constructed. This might even have reinforced the group members' learning experiences.

6.5 Substudy V

Mäkitalo, K., Weinberger, A., Häkkinen, P., Järvelä, S. & Fischer, F. 2005. Epistemic cooperation scripts in online learning environments: Fostering learning by reducing uncertainty in discourse? *Computers in Human Behavior*, 21 (4), 603–622.

This study examined the effects of an epistemic cooperation script on the amount of discourse and information-seeking activities generated and the quality of the learning outcomes achieved in collaborative learning as compared to unscripted collaborative learning. The aim was also to look at the ways in which learners seek and receive information and the nature of the information thus pursued and obtained by them and the ways in which their learning partners react to such exchanges of information. The participants were 48 students randomly assigned to groups of three in two conditions, one with and one without an epistemic script. The discussion data was approached both quantitatively and qualitatively. Individual learning outcomes were measured with a post-test based on a problem case.

The findings indicate that the epistemic script did, indeed, increase the amount of discourse. In other words, the learners in the epistemic script group contributed and exchanged longer messages than the learners in the unscripted group. On the other hand, in the epistemic script group the learners put in less effort to seek information than the unscripted group learners. These two results - that the epistemic script group exchanged longer messages and was less diligent about seeking information - support the idea that this type of script reduces uncertainty. While these were predictable findings, more unexpected results emerged on learning outcomes, showing that the students in the unscripted condition had better learning outcomes than those in the epistemic script condition. In order to discover the reason to this, we investigated two groups from each condition in more detail.

While both groups pursued various forms of information, for example looking for ideas and trying to verify assumptions, the ways in which they sought, responded to and received information were different. The epistemic script group learners were less active in responding to information seeking. Indirect approaches to acquiring information were not successful because learning partners failed to react to these initiatives. Therefore, there was little information for the information seekers to receive and elaborate on. The learners in the unscripted group, in contrast, sought information more directly by clearly indicating their lack of understanding. Their learning partners responded by providing the information, ideas or verification that had been asked for. Moreover, the unscripted group participants also recognised, used and referred to the information thus received. The learners in the unscripted group engaged in information-seeking processes and in so doing solved their problems together, which may have contributed to their good learning outcomes.

7

Main Findings and Conclusion

Because of the growing interest in online learning environments in educational contexts, computer-mediated communication should be explored with a view to helping learners to interact and learn collaboratively in online environments. We should similarly help teachers to design online courses and supervise their students' online learning. The aim of this dissertation was to take a look at online collaborative interaction and learning in authentic and experimental higher education settings. Previously, grounding processes have been examined in face-to-face and online situations where the focus has been mostly on the cognitive aspects of collaboration and on how learners build shared understanding concerning a particular issue. However, interaction and collaboration are complex phenomena not only in face-to-face contexts but also in online conditions, and these processes should not be simplified by resorting to one-sided theoretical perspectives or analytic methods. In this dissertation, a variety of quantitative and qualitative approaches were employed to investigate the mechanisms of establishing and maintaining common ground, the ways in which learners build shared understanding and knowledge, and the effects of scripts on interaction and learning. In two of the five substudies (Substudies III and IV), a qualitative procedure was chosen as best suited to the research purposes for which we undertook this study of the mechanisms of common ground and shared understanding in small groups. The aim of this general discussion is to offer some conclusions derived from and suggestions based on the empirical studies making up the thesis. A further aim is to go beyond current studies by putting forward a reconstructed theoretical model of the grounding process and proposing some general ideas regarding research on CSCL and its pedagogy.

7.1 Theoretical Contribution

7.1.1 Collaborative Activities From the Perspective of Common Ground

Considered together, the results of the five substudies show that interaction in online collaborative learning environments is an intricate phenomenon. Successful interaction and collaboration require participants to enter into collaborative activities, make an equal contribution, and share their prior knowledge, beliefs, assumptions and feelings freely with each other. According to Barron (2003), collaboration involves a dual-problem space where learners must engage in and develop a content (cognitive) space and a relational (socio-emotional) space. It seems that the grounding process brings learners in online learning environments face to face with a dual-problem space of this kind as they work to build and maintain common ground. This dissertation was intended as a description of the major mechanisms underlying collaborative activities. The mechanisms constituting the grounding process are basic elements which can enhance teamwork or whose absence can, on the other hand, limit learners' ability to work as a team and achieve shared understanding in knowledge-building activities.

Learners must pay close attention to the content space so as to be able to understand what their fellow learners are saying and also think carefully about what to say to the other learners and how to say it so that these understand what they themselves are saying. On the other hand, learners must understand the relational space where group work takes place, the wishes and abilities of their fellow learners, and the things that they and their fellow learners can do together as a group and the ways in which their work will progress efficiently. Besides this, an individual learner must be aware of whether their fellow learners are willing and able to make contact and recognise important ideas and suggestions and ready to listen to and respond to their learning partners. Further, those taking part in online collaborative learning must also be able to be present and make their presence known in an appropriate way. Reaching shared understanding in both the content and the relational space is an essential precondition of a group of learners solving a problem or completing a task together. Employing these mechanisms helps learners to establish and maintain common ground that will serve them as a foundation of their collaborative activities. Moreover, these mechanisms are so commonplace in daily communication that they are mostly quite invisible and little noticed. On the other hand, the absence of mechanisms of this kind can undermine a learner group's sense of togetherness and cause problems among participants interacting in online learning environments. In computer-mediated communication, which is mainly text-based, there are participants quite familiar with these mechanisms.

However, short discussion threads and superficial discussions demonstrate that we need to know more about how the mechanisms of common ground should be used in practice.

7.1.1.1 Mechanisms of Common Ground

In Substudies I-III, the aim was to investigate the mechanisms of establishing and maintaining common ground. The results of Substudy I show that in order to gain shared understanding and knowledge students must put in more effort to solve the cases successfully because as it was, their discussions consisted of monologues instead of dialogues. This seems to be a common problem in computer-mediated communication. Sophisticated messages, such as theory-based ones, do not help much if fellow learners fail to turn them to good account. However, in Substudy II, which focused on comparing types of feedback given and questions asked at different levels of discussion, it was found that supporting feedback was more frequent in deeper-level discussions than in progressive-level discussions. In other words, deeper-level discussions were typically characterised by constructive communication between participants. The findings of this substudy imply that in order to create and sustain common ground, those engaged in computer-mediated communication should provide feedback and ask questions of a kind that promotes constructive online interaction. The question patterns that emerged in deeper-level discussions - including theory-based considerations, attention to relationships between different factors relevant to the task facing the students, and negotiation over the conclusions to be drawn - were intellectually more challenging than those found in progressive-level discussions. In an online learning environment, sharing and asking for facts are easier activities than is asking for deeper explanations as a means of making sense of a phenomenon or issue (see also Mulder et al. 2004). Asking questions enables students to display their interest in continued interaction with each other. Thus, a particular pattern of questions can be seen as mechanism for maintaining common ground, but questions can also be recognised as feedback to fellow learners. Questions and feedback allow learners to check how their fellow learners understand the issues at hand, which may be helpful when building shared understanding in a group. However, the discussions analysed here involved relatively superficial exchanges of opinion, suggestions and disconnected pieces of information rather than deep and interactive knowledge building where learners come together to elaborate and critically value information. A possible explanation for this state of affairs is that the learners missed their shared goal, which affected their joint focus on solving the problems set for them (Substudies I & II). This meant that they lacked a shared goal and, with this, a basis for collaborative activities.

All five substudies demonstrated that the mechanisms for building and sustaining common ground are used in a variety of ways depending on the nature of the collaboration task,

the make-up of the collaborators (students, students and mentors etc), any previous relationships between them, the conditions under which collaboration is intended to take place (face to face, mediated by computer), its setting (classroom, home etc), the form of communication on which it is to be based (synchronous or asynchronous), and the time period scheduled for it (hours, days or months) (see Dillenbourg 1999).

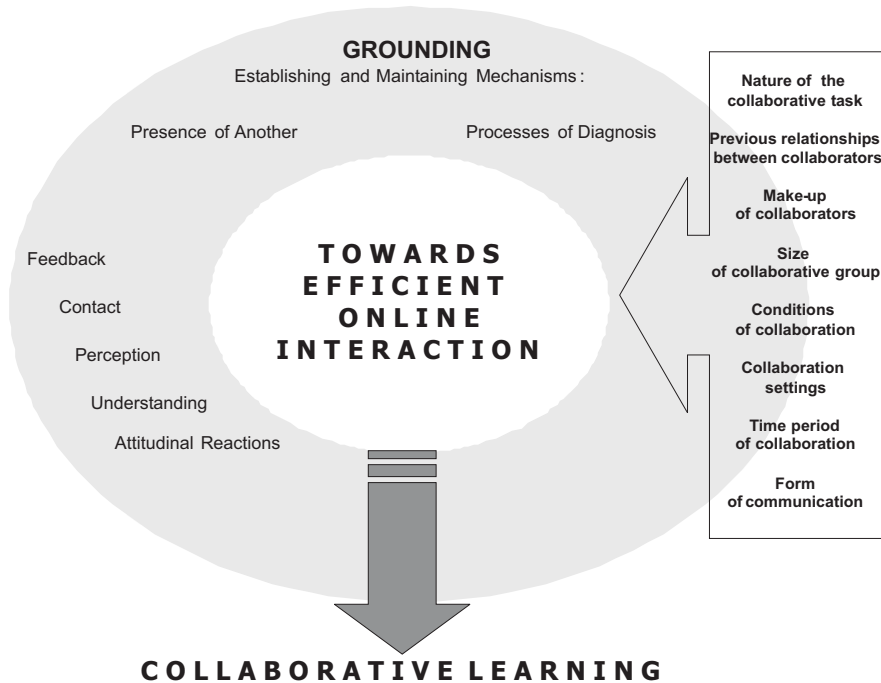


Figure 2. *The mechanisms for building and maintaining common ground in online learning environments and the factors affecting their use.*

The findings of the five substudies show that some learners come to online learning environments with grounding mechanisms already mastered as something natural; they simply transform the skills and knowledge involved to meet the needs that arise in a new and different environment. Such mechanisms are exploited daily, they are a part of our everyday life but are too mundane and obvious for us to pay much attention to them (see Mercer 2003). However, when discussion participants must communicate in a different setting and in a different way, as they must in online learning, they may not be able to transfer and adapt these familiar skills and knowledge for employment in the new environment. Therefore, some learners may require help with and guidance on how to use grounding mecha-

nisms in online contexts. Joint goals and a shared understanding of these goals may play a great role in how effectively learners focus on their joint online activity and how much effort they put in to establish and maintain common ground. Another reason why these simple daily mechanisms are important is because their absence can paralyse interaction and collaboration among online learners.

The crucial function of these mechanisms is an indication of the complex and multifaceted character of interaction as an aspect of collaborative activities. It involves both a relational and a content level, manifested at the linguistic level because communication in online learning environments is text-based. Because the first three substudies making up this dissertation scrutinised the mechanisms of common ground, they missed one of the important features of online interaction, that is, how groups build shared understanding and knowledge regarding their learning task. Substudy IV took up not only the cognitive processes underpinning collaboration on the line but also its contextual features, such as the tools and resources that learners use in a small group.

7.1.1.2 From Multiple Perspectives to Shared Understanding

Online learning environments open up a wide range of opportunities for collaborative learning and working across distance and, in higher education, across cross-curriculum projects and between different levels of expertise. However, online learning environments do not always produce successful outcomes. The substudies included in this dissertation demonstrate that individual messages, even when they are cognitively sophisticated, are not always effective in enhancing collaboration. A learner can share their prior knowledge, but a group of learners need to put in effort also to building shared understanding and knowledge. Sharing one's existing knowledge with one's fellow learners is the same as possessing shared knowledge constructed on the basis of this pooled individual knowledge only if the learners are refraining from elaborating further on their current understanding and knowledge base. As Figure 3 (see also the Johari Window; Luft 1984) shows, in order to construct shared understanding and knowledge learners A and B need to share their prior understanding, assumptions, beliefs, presuppositions and feelings and make these explicit in their discourse in collaborative situations. The idea is that a learner is not a tabula rasa but that because of differences in backgrounds and cultures, two learners' prior knowledge becomes visible between them only when they make it explicit through interaction. To render this possible, both must be willing to work towards shared understanding or group cognition, as Stahl (2005) describes the process. The knowledge shared between the two learners becomes their tacit knowledge, available as a resource for building further new understanding and knowledge.

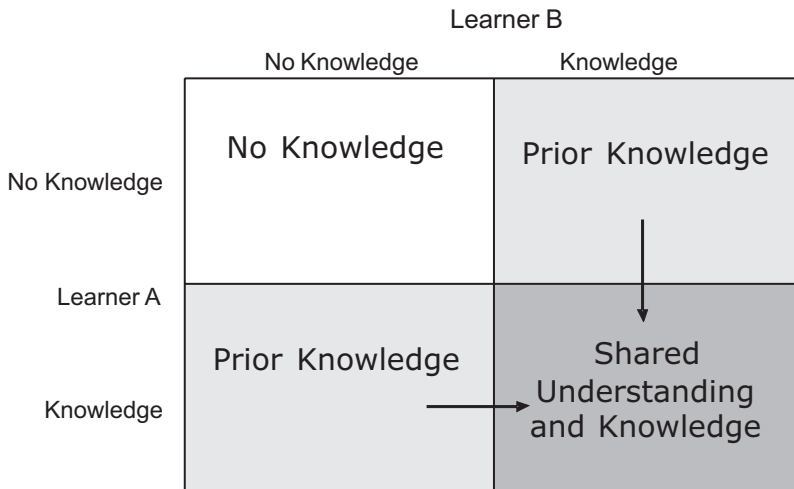


Figure 3. *Building shared understanding between two learners in collaborative learning activities.*

This raises a question about the individual choices made in the process of building shared knowledge: Is a learner contributing to their group's knowledge-building activities? Is this contribution accepted, rejected or elaborated by the other learners? How does the group use its members' inputs to build understanding and knowledge shared within it? Such choices are a matter of group processes and learners' joint effort to perform a task or solve a problem.

Substudies IV and V suggest that successful learners exert themselves to build shared goals, understanding and knowledge. As Substudy V indicates, information seeking was successful if fellow learners responded to it and if the learner looking for information went on to further elaborate the information thus received. Substudy IV shows that the learners built shared understanding and knowledge using a variety of different tools and resources. In the group studied, prior knowledge was not always made visible in group-level discussions. However, the outcomes of the group processes reveal that knowledge not discussed became visible at other points of group processes, which may imply that it was silently accepted as knowledge in common between the group members. The group built knowledge through a cyclical process (Stahl 2004). Also, as regards the particular group investigated in Substudy IV, it can be assumed that they gained shared understanding because there was no evidence to the contrary (disagreements, clarifications, breakdowns of communication; see Clark & Schaefer 1989; Stahl 2003). On the other hand, interaction can be successful and productive also without conflict since differing opinions are not necessarily mutually ex-

clusive but can, instead, be interpreted as equally valid alternative perspectives, which may contribute to a group's work on its task.

Learners must maintain and consolidate their common ground during their interaction itself if they are to be able to explore new aspects of their shared knowledge base. In Substudy IV, the group was constantly reflecting on their joint activities as they discussed their theoretical framework. They integrated their theoretical knowledge into their experienced joint activity. On the one hand, this may have helped them to build a shared understanding of their theoretical content. On the other hand, the goals they set themselves may have contributed to shaping the way in which they processed the relevant information because their aim was to design an experimental project where they would share their experiences. However, it is important to remember that in the final analysis, while the grounding opportunities as such are made available by the system where learners interact, what matters is whether the learners themselves decide to make more active use of the different grounding mechanisms accessible to them (Pfister 2005).

7.1.2 Content-Related Scripting and Uncertainty

A recent approach to the facilitation of online collaborative learning at the process level is providing learners with help and support in the form of scripts that specify and sequence their collaborative learning activities. These scripts can be also seen as tools to help learners build and maintain common ground (within the content and the relational space) in online learning environments. If learners do not know each other or are not familiar with new forms of communication or learning (collaborative learning) and new learning environments, the resulting uncertainty may influence collaboration in a number of ways. Online collaborative learning can be promoted at the process level by designing collaboration scripts that support learners in specific dimensions of collaborative learning, such as content-related (epistemic) activities. The effects of an epistemic script on the amount of discourse and information seeking generated and the quality of the individual learning outcomes achieved in collaborative learning were investigated in Substudy V.

The twin findings that the epistemic script group exchanged longer messages and put in less effort to seek information support the view that content-related (epistemic) scripts reduce uncertainty. As regards learning outcomes, the students in the unscripted condition did better than those in the epistemic script condition. In order to discover the reason for this, we looked more closely at two groups from each condition. While both groups pursued various forms of information, for example looking for ideas and trying to verify assumptions, the ways in which they sought, responded to and received information were different. The participants in the more successful group (the group with better learning outcomes) pursued information more directly by clearly indicating their lack of understand-

ing. Their learning partners responded by providing the information or ideas that had been asked for or by verifying or refuting the assumptions put to the test. The participants in the successful group also recognised, used and referred to the information thus received. One reason why the group's learning outcomes were better might lie in the way in which uncertainty promotes beneficial interaction patterns, including information-seeking processes (see King 1999; Webb 1989). This may also imply that as they exchanged information, the learners were actually building shared understanding and knowledge of the particular issue under discussion. In other words, the successful group was willing to exert themselves more to create and maintain common ground to underpin their collaborative activities.

It is generally assumed that in online learning environments, participants automatically start interacting with each other (Kreijns et al. 2003). However, besides the cognitive aspects of collaborative learning processes and their outcomes there are other facets of learning that require attention. Crucial problems concerning interaction in online learning environments can emerge also in the relational space, that is, at the social and emotional levels of collaboration (see also Gunawardena 1995). Kreijns, Kirschner, Van Buuren and Jochems (2004) point out that the level of sociability generated by online environments, that is, how good they are at smoothing the way for the emergence of social space, is a crucial factor in the success of online learning. We should focus on identifying the kinds of script that reduce uncertainty at the social level without losing the benefits of information-seeking activities. The aim of a social script is to facilitate interaction between learners by specifying different roles for them to assume, for example the roles of a case analyst and a constructive critic (Weinberger et al. 2005). According to Weinberger and his colleagues, the social script tried out in their study not only persuaded the learners to take on a broader range of roles but also encouraged the application of theoretical concepts to the problem space and the articulation of multiple perspectives on the subject discussed.

It can be assumed that a social script reduces social uncertainty between learners because, as happens in the study by Weinberger and others, assuming the roles made available to them guide learners to interact with each other (see Weinberger et al. 2005). On the other hand, a social script may also have a side effect on cognitive uncertainty, given that the learners in the study were able to share and construct knowledge and also attained a good learning outcome. However, further research is needed on the multiple levels of uncertainty present in an online collaborative learning environment and their relation to individual learning outcomes. We must also find out what generates certainty or uncertainty or what motives compete with uncertainty reduction during interaction. Reducing uncertainty can have both positive and negative outcomes, as is shown in Substudy V (see also Kramer 1999). Kramer (1999), argues that the perceived value of social interaction may motivate learners more powerfully to communicate than does the intention to reduce uncertainty. Also, learners can have a disposition to active seeking of information even when their motivation to

reduce uncertainty is low. It would also be interesting to explore the sources that learners turn to when they are after information, for in authentic settings there are a variety of sources, such as teachers, fellow learners, books, the Internet, where to search for information to reduce uncertainty (see Kramer 1999).

When scripting learner interaction in online learning environments, we should make the scripts adaptable to different contexts. The effects of scripts must be generalisable to other types of task and domain. Apart from requiring adjustment to different learning goals within different domains, scripts may need to be modified as to the difficulty or complexity of the learning tasks involved (Reiser 2002). Furthermore, it should be possible to adapt them to the specific characteristics and requirements of small groups. For instance, there are indications that the more knowledge learners possess, the less specifically should a script pre-structure their individual collaborative learning activities (Cohen 1994). Moreover, we should consider what other scripts may already be operating in learners' minds or in the learning environment (internal scripts & external scripts; see Kollar, Fischer & Slotta 2005). Their long-term effects are another aspect of scripts that should be looked at; for example, scripts can be faded out in order to see if learners adjust their techniques when there are no longer scripts to guide them (see Carmien, Kollar, Fischer & Fischer 2005; Rummel & Spada 2005). In this way, scripts may be made to reach beyond small-group interaction and also structure the communicative approach of whole classrooms or schools, for example by calling for small-group products to be made available to the whole classroom or published on the school web site.

7.1.3 Learning in Online Groups

The last two Substudies, IV and V, paid more attention also to the issue of students' learning experiences and outcomes. Substudy IV described the learners' own experiences at the group and the individual level, while Substudy V measured the individual learning outcomes with a post-test. Substudy IV concentrated on capturing the group processes where learning was supposed to have taken place as described by Stahl (2005), including also the participants' learning experience as a group and as individuals. The substudy was based on a conception of learning that sees individuals as learning in collaborative situations by sharing and building knowledge together. The results of Substudy V indicate that the uncertainty which arose in the unscripted condition improved learning outcomes. This could be regarded as implying that learning environments should provide some degree of uncertainty. With respect to the uncertainty reduction theory, the results suggest that uncertainty is not always a barrier to successful interactions. A possible explanation for this positive effect is that uncertainty fosters beneficial interaction patterns, which include information seeking.

In Substudy IV, the learners' reflection on their learning experiences reveals that they learnt more through participation in their joint activities than by building their theoretical framework as a group. The learners used narrative as a conceptual artefact to scaffold their learning on a foundation of shared history, their past experiences and their current joint activities (see Boland & Tenkasi 1995; Yukawa 2005). Further, they articulated multiple perspectives on the issue assigned to them and drew on theories from different fields such as education, communication and psychology. When they gave thought to their experiences at a group level, it became apparent that they had not gained their learning from building their theoretical framework through book summaries. A possible explanation is that the two processes involved in this, mastering the content to be learned and engaging in the activities entailed by it, were so closely related that it might have been hard for them to separate the various learning experiences. Thus, an analysis of the individual learning experiences shows that the learners learnt from the book summaries as they made, edited and read them. It is possible that the learners' self-constructed explanations were important for their learning when they were drawing up individual documents such as summaries of the books they had read or different records and contributions representing their own ideas (see Jeong & Chi 1997). In this way, they had to make their own interpretations and understanding visible, which may have enhanced their own thinking and learning (see King 1999).

These two substudies demonstrate that those learners who gained good learning outcomes or good learning experiences engaged with and developed both the content space and the relational space as they went about their collaborative activities (see Barron 2003). They addressed a common task or problem and pursued shared goals. In the critical phases of collaborative activities their joint attention was focused on the learning task. The successful learners were able to make an equal contribution to group knowledge building by listening to one another's ideas and suggestions, acknowledging them, adding new points and developing these further. The absence of a fellow learner seemed to disturb the collaborative learning activities, which testifies to the importance of equal participation.

According to Crook (2000), at the core of the ecology of collaboration lies a perception of the collaborative and motivational processes of learning and the technological tools mediating the related social interactions as merged into a whole uniquely situated in a particular context. Collaboration in computer-supported environments is about much more than becoming familiar with a subject matter. It is about collaborating to learn and learning to collaborate in a specific context. The quality of learning experiences, as valued by learners themselves, can vary. Current educational culture encourages university students to pass exams, which leads them to adopt a superficial and instrumental approach to their studies (see Kanuka 2005; Mandl, Gruber & Renkl 1996). We could ask how good collaborative learning might be defined or what kind of collaborative learning is expected and appreciat-

ed in higher education. In the open learning tasks examined in this dissertation (Substudy IV), the students themselves decided what they wanted to learn, and this was not necessarily what the lecturers and the researchers thought they should learn. The findings reveal that the learners have learnt a great deal, such as acquiring skills needed for participation in collaborative activities and becoming familiar with various technical and content-related issues, but above all they gained positive experiences of collaboration, which might affect them as future teachers and encourage them to tailor collaborative learning and, it is to be hoped, also online learning environments for use in their own classroom. If the teacher education project reported on here achieved this, it would be what I, as a teacher educator and researcher, would like to call a jackpot.

7.1.4 A Model of Areas of the Grounding Process in Collaborative Activities

To obtain a more detailed presentation of the different (cognitive, socio-emotional, contextual) features of common ground and the processes of shared understanding, we could apply and modify the model of the Johari Window (Luft 1984; Chapman 1995–2005). The Johari Window captures behaviour, empathy, cooperation, inter-group development and interpersonal development more precisely than other descriptions. It would make possible an integration of the theories of common ground and uncertainty reduction with the outcomes of the substudies, producing a more comprehensive picture of the significant areas of the grounding process as it operates in computer-supported collaborative learning environments (see Figure 4). These theories support each other, while the mechanisms of common ground and uncertainty reduction strategies can be seen as techniques which allow learners to move to an area of constructive and effective communication and collaboration. The Johari Window can help us to understand personal development and train for it, improve communicative and collaborative activity, and enhance interpersonal relationships, group dynamics, team development and inter-group relationships (Chapman 1995–2005). Moreover, it can be seen as an information processing tool. The Johari Window links information, such as data on feelings, experiences, opinions, attitudes, skills, intentions, motivation and so on associated with a person as a member of a group and presents it from four perspectives (Luft 1984). This is information important to share in the grounding process. The four perspectives are the area of common ground, the blind area, the hidden and avoided area and the unknown area (or, as it could also be termed, the area of no common ground).

The area of common ground contains those things that a person knows about themselves and that are also known to other people (Luft 1984). In terms of common ground, this can be interpreted to mean that this is where the members of a group find common

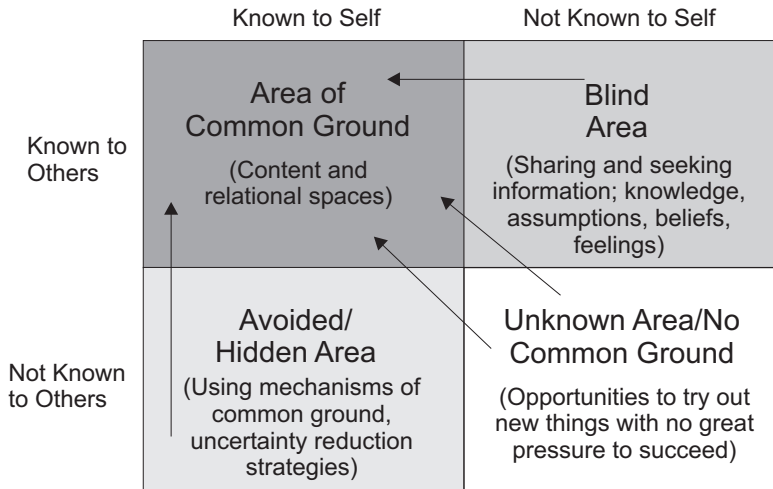


Figure 4. *A model of areas of the grounding process in collaborative activities (adapted from the Johari Window model).*

ground and reach shared understanding. The area of common ground may be seen as the space where effective communication and collaboration occurs (Chapman 1995–2005). Group members can expand their area of common ground by using the mechanisms of common ground and the strategies of uncertainty reduction, for example by offering supportive and constructive feedback or disclosing their feelings and personal information to the group. The blind area is where lie those things about themselves that are unknown to a person but which other people know (Luft 1984). This is not an area where individual learners or groups of learners operate effectively because groups are not working well if there is information relevant to their relational and content spaces that is not shared with every learner in a group (see also Chapman 1995–2005). Such selective distribution of information might also increase uncertainty between learners. To avoid this, learners can use the mechanisms of common ground or uncertainty reduction strategies, such as giving sensitive feedback, making contact, seeking and providing information and encouraging fellow learners to disclose their knowledge and so on.

The hidden area contains those things that learners know about themselves but that are not known to other people (Luft 1984). Relevant hidden information and feelings should be transferred to the area of common ground through the process of grounding by sharing knowledge, assumptions, presuppositions and emotions among group members. This can make for better understanding, improved collaboration, enhanced trust, more effective teamwork and greater productivity. Reducing hidden areas reduces also the potential for

misunderstanding and confusion (Chapman 1995–2005). The unknown area (the area of no common ground) holds what the learners do not know about themselves and is unknown also to other people (Luft 1984). These unknown issues can take a variety of forms, such as feelings, behaviours, attitudes, capabilities, aptitudes (see Chapman 1995–2005). Learners can have abilities which may have been under- or over-estimated (see also Dillenbourg 2002 on overscripting) or they may lack opportunities, encouragement, confidence and training. They can be unable to employ the mechanisms of common ground in new learning environments despite these being seen as natural skills. Also, scripts could open learners access to an area where they can enter into constructive and effective communication and collaboration (see Carmien et al. 2005).

Such unknown issues can come to light in new or other special situations and environments as a result of collective discovery (Chapman 1995–2005). Hidden issues of this kind affecting an individual learner may be discovered by the individuals themselves or by their fellow learners. Here learners, if they use the mechanisms of common ground or uncertainty reduction strategies successfully, are actually moving from the unknown area to the area of common ground through either the avoided or hidden area or the blind area. In education, learners should be provided with opportunities to try out new things without feeling any great pressure to succeed, which can be a good way to detect unknown abilities, thereby shrinking the unknown area (Chapman 1995–2005). This model of areas of the grounding process could help not only educators to support learners but also designers to create environments and scripts that enable learners to move to the area of common ground. It can help also researchers to explore interaction and learning in online learning environments; in particular, it can help them to focus on the hidden areas of grounding processes, research of a kind that is lacking in the field of computer-supported collaborative learning.

7.2 Methodological Challenges

One of the aims pursued in this dissertation was to develop methods for examining interaction, especially the mechanisms of common ground as they are brought into play in collaborative learning situations, and the ways in which scripting affects uncertainty, interaction and learning. Different theories from education, psychology, communication and instructional design were exploited in order to analyse these complex phenomena. Further, there was a mix of quantitative and qualitative approaches, which can be seen as one of the advantages of this study. The strength of research based on quantitative methods and a large number of subjects is that the results are generalisable. By contrast, a small number of subjects limits the scope for generalisation, but at the same time it offers an opportunity for a more in-depth investigation. The strength of qualitative approaches is that the given phe-

nomenon can be scrutinised more closely and in more detail to pinpoint the broad range of variables involved in interaction and collaboration.

The first four substudies (I–IV) were conducted in authentic higher education settings and based on ill-defined learning tasks. This meant that it was not feasible to measure student achievement with ready-made pre- and post-tests. Thus, a possibility would have been to assess the learning outcomes by asking the students to write essays on a topic chosen by themselves. Two substudies (III & IV) had a small number of subjects because only one of the six groups involved used the online learning environment, making a comparison between different groups impossible. A further challenge is to study a larger population and look at how individual groups employ different mechanisms of common ground, a topic on which we already have some empirical evidence derived from Substudies II–III.

There is a need also to find out how students draw on various resources to build shared understanding and knowledge and what they learn as a group and as individuals in larger populations. The model of areas of the grounding process suggest that it might be useful to concentrate further research on the blind, hidden and unknown areas (the area of no common ground) in order to discover what it is that a learner knows about themselves which remains unknown to their fellow learners and what, on the other hand, it is that is unknown to the learner about themselves but known to their fellow learners. Focusing also on the unknown area to determine what is unknown both to individual learners themselves and their fellow learners could be worth the effort as a way of identifying unknown abilities and fears, which can surface in online situations. An important issue concerns the measurement of learning outcomes. Assessing the effectiveness of collaboration only with pre- and post-tests implies a flawed grasp of the idea of collaborative learning and interaction in online learning environments (see Crook 2000). The nature of collaborative learning suggests that learning and collaboration should be evaluated also on the basis of the interactive learning process itself, an idea which should be developed further (see Chan & Van Aalst 2004).

7.3 Educational Implications

It seems that university students tend to adopt a superficial and instrumental approach to their studies (Kanuka 2005; Mandl et al. 1996), which is reproduced in online learning environments. Instead, they should be encouraged to develop deep learning styles. Those designing and delivering higher education might assume that students possess skills and knowledge that enable them to collaborate (see the model of the areas of the grounding processes), but in the light of the substudies making up this dissertation, students require more guidance and support. Their cognitive, interactional and social skills are all highly

relevant to meaningful and productive collaborative learning activity. They are unfamiliar with testing syntheses, summarising agreements, opinions and ideas, and applying newly constructed knowledge (see Kanuka 2005). And even when they are willing and able to engage in these processes, they are unaccustomed to recording their results during a discussion (Kanuka 2005). Higher education must devise practices for collaborating to learn and practices for learning to collaborate.

Or, rather, learning to collaborate is already being consciously promoted in higher education through the design of different tools or scripts supposed to help learners to interact and work together with each other. However, learners may not be able to put such tools to appropriate and successful uses or do this without guidance if they are unclear about the basic rules of collaborative activities. Even well-designed tools might not reach the goals set by their designers and by the educators who have taken them up. Moreover, most previous research on online collaborative learning involved short-term experiments where students had too little time and opportunity to practise the skills needed and gain deeper understanding and knowledge about the phenomenon called collaborative learning. The findings of previous studies concerning, for example, superficial discourse, short discussion threads and limited sharing of knowledge can be partly a consequence of a lack of collaboration skills. Long-term experiments in authentic higher education contexts might help us to explore this aspect of collaborative learning. It might also be worthwhile to see what happens if students taking part in an experiment are, before the experiment is started, taught those basic rules of collaboration that are calculated to lead to efficient interaction (see Mercer 2003; Wegerif, Mercer & Dawes 1999).

The most challenging task facing research on online collaborative learning is transferring the implications of research projects out into the field and modifying and revising the practices current there to form a part of a new culture of schooling (Hakkarainen et al. 2002; Lipponen 2001; Sinko & Lehtinen 1998). Computer-supported social interaction and knowledge building are connected with the creation of learning cultures of a new kind (Hakkarainen et al. 2002; Scardamalia & Bereiter 1994). These cultures make available innovative and novel learning opportunities, but their introduction to prevailing school culture will not be easy and unproblematic. Stahl (2005) puts forward an interesting idea about a theoretical confusion between learning and group knowledge, which can be seen as a barrier both to educational practice and educational research. Teachers, students and researchers see learning as an individual issue, failing to grasp the true potential of collaborative learning because they lack an awareness that groups can construct knowledge together in a way impossible for single individuals and that group learning can turn out to enhance individual learning (Stahl 2005). An understanding of the perspective of group learning would enable us to adapt this new innovative approach more easily to the daily work going on in educational settings. Researchers should also disseminate the innovative new instruc-

tional practices elaborated by them more openly among teachers and other practitioners. However, it requires long-term commitment by and collaboration between researchers and practitioners before these new instructional practices can become an element in a new culture of schooling (Häkkinen et al. 2004).

7.4 Evaluation of the Study

The aim of this dissertation was to look at online interaction and learning and, more specifically, at the mechanisms of grounding processes, shared understanding and knowledge building and at how scripting affects uncertainty, interaction and learning. Four of the five substudies (I-IV) focused more directly on grounding processes and common ground while Substudy V centred its attention on scripting and uncertainty.

A possible limitation of Substudies I–III is that they include no measures of learning outcomes or learning experiences. The first three studies (I–III) were concerned primarily with examining interaction and gave too little consideration to what the students actually learnt. These three studies were underpinned by an assumption that learning takes place whenever discussions between learners reach a deeper level. Such deeper-level discussions bring into play sophisticated contributions such as theory-based messages and messages raising new points or questions and messages containing relevant responses to sophisticated contributions of this kind. In Substudy IV, the researcher faced the methodological challenge of keeping track of a group process that was all the time shaped also by tacit assumptions and knowledge not shared in visible ways as the group members interacted in the online learning environment. Observing or interviewing learners in the classroom context might produce valuable information about the group process through which learners reach shared understanding. Substudy V may be limited by a lack of a subjective measure for uncertainty. As a result, the data offers no direct support to the assumption that the script reduced the learners' subjectively experienced uncertainty. Uncertainty has been measured in, for example, social psychology (Budescu et al. 1990; Gärling et al. 1998) and in clinical and health policy (Balsa et al. 2003; McCormick 2002). These approaches might be adapted for use in the field of collaborative learning in higher education and in online learning contexts. Another possible shortcoming of Substudy V is the way in which it operationalises uncertainty, given that the control condition included a number of structural elements (e.g. task descriptions, cases, theoretical texts, threaded discussion boards) that may themselves have substantially reduced uncertainty.

Qualitative content analysis made it possible to explore the research data employing both theory- and data-driven approaches. Analysis of this type gives a researcher the freedom to move between the macro level and the micro level and look at the materials from perspectives ranging from a focus on their broader aspects to attention to their more specif-

ic features. Qualitative content analysis seems to capture the different elements of the data better than do quantitative approaches (see Gerbic & Stacey 2005). It is true that there are problems. On one hand, using a variety of analytic units makes it difficult for other researchers to apply the same methods in further studies (see Strijbos et al. 2005). On the other hand, while qualitative content analysis and a data-driven approach allow an examination of the shared processes that emerge and the shared understanding that arises in particular groups in online learning environments, at the same time this type of analysis reduces the scope for generalising the results (see Patton 1990). Moreover, it is important to keep in mind that the findings concerning interaction and learning in online collaborative learning environments presented here are the researcher's interpretations and that other interpretations can also be found. Exploiting a combination of quantitative and qualitative analyses offered a fruitful method for considering the large amount of data in more detail, for example by concentrating on data describing individual learner groups. The advantage of quantitative analysis is that it is strongly grounded on a theoretical framework. However, it has the disadvantage that it cannot take into account the situational features that surface when scrutinising collaboration in online learning environments. A further challenge is developing a range of both quantitative and qualitative methods suitable for examining interaction and learning as they are affected by different features (social, emotional, situational) present in online learning environments.

The results of these five studies have not been generalised here because the number of subjects was small. Instead, they enhance our understanding of online interaction and learning especially by identifying mechanisms that seem to play an important role in the process of establishing and maintaining common ground and by casting light on the ways in which different resources can help learners to share their own perspectives with a view to building shared understanding in online learning environments. Most of the previous studies of common ground analysed face-to-face interaction at the computer; what was needed was more information about the grounding processes as they operate in online learning environments. As the reconstructed model of grounding process offered in this dissertation suggests, future research should continue to investigate grounding processes in large samples of subjects, which may help to gain generalisable results and, therefore, generate better research on computer-supported collaborative learning.

The main advantage of this study is that it examined online interaction as it takes place in different groups in authentic and experimental higher education contexts. It is quite rare in the field of computer-supported collaborative learning to follow the activity history of a single group from the beginning to the end of an online course. By adopting this approach, the study gained some basic data on and knowledge about online communication and learning. Because the research subjects came from three different countries, it has made clear that the problems that must be addressed in online communication are similar across dif-

ferent cultures. Its insight into the individual and group perspective as factors in learning corroborated, by producing more evidence to support it, the view that learning and assessment should be integrated into a single process and that the activities involved in collaborative learning are much more complicated than their outcomes alone reveal (see also Dochy 2005). Assessment should focus not only on the individual group members and their final product but also on the group processes. Moreover, account should be taken of both individual and group learning because different groups and different individuals inside one and the same group learn different things.

To conclude, the aim of this study was to extend our understanding of online communication, collaboration and learning. It has demonstrated that interaction and learning are complex phenomena and that there are many factors and elements that need to be taken into consideration if we want to grasp the full diversity of collaborative learning situations. The reconstructed model of grounding process, which integrates the different approaches, such as the Johari Window, the concept of grounding, and the uncertainty reduction theory, is proposed as a useful starting point for explorations of interaction and learning in online learning environments. There is no doubt that there will be problems and challenges facing designers who create online learning environments and educators who supervise and teach learners operating in them, but this study was able, to some degree, to add to our knowledge of online interaction, collaboration and learning.

Yhteenvedo

Mäkitalo, K. 2006

Vuorovaikutus verkko-oppimisympäristöissä:
Yhteisöllisen toiminnan tukeminen korkeakoulukonteksteissa

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Johdanto

Uuden teknologian myötä on tullut mahdolliseksi suunnitella uudenlaisia opetus- ja oppimistilanteita, jotka perustuvat verkostoperustaisen yhteisöllisen oppimisen periaatteisiin. Teknologiaa hyödyntävien oppimisympäristöjen käyttö voi tukea syvempää ymmärtämistä ja tiedon rakentamista opiskeltavasta aiheesta tarjoamalla välineitä erilaisten vaihtoehtojen jakamiseen ja pohdintaan, kyselemiseen, selittämiseen, kriittiseen arviointiin sekä kommunikointiin kanssaopiskelijoiden sekä asiantuntijoiden kanssa (Crook 1999; Häkkinen ym. 2004; Koschmann 1996; Scardamalia & Bereiter 1994; Strijbos ym. 2004). Verkko vuorovaikutuksesta puhuttaessa voidaan viitata samanaikaiseen eli synkroniseen tai eriaikaiseen eli asynkroniseen kahden tai useamman henkilön väliseen vuorovaikutukseen. Synkroninen vuorovaikutus on useimmiten ”chatti”-pohjaista, jolloin osallistujat ovat samaan aikaan verkossa. Asynkroninen vuorovaikutus taas tapahtuu useimmiten erilaisten verkkopohjaisten keskustelufoorumien välityksellä, jolloin osallistujat ottavat osaa keskusteluihin heille parhaiten sopivana aikana. Yhteistä on se, että sekä samanaikainen että eriaikainen vuorovaikutus on useimmiten tekstipohjaista. Tässä tutkimuksessa tarkastellaan erityisesti tekstipohjaista eriaikaista vuorovaikutusta, jota myös yleisimmin käytetään erilaisissa verkko-oppimisympäristöissä.

Optimistisimpien näkemysten mukaan mikä tahansa verkossa tapahtuva vuorovaikutus on oppimisen kannalta arvokasta. Teknologian tarjoamat puitteet eivät kuitenkaan aina takaa sitä, että verkkoympäristöissä tapahtuu laadukasta vuorovaikutusta, joka tukisi oppimista. Aikaisempien tutkimusten mukaan verkkokeskustelujen laatu on usein pinnallista. Verkkokeskusteluissa tiedon jakamista sekä sen kriittistä pohdintaa ja rakentamista esiintyy vähän (mm. Hara ym. 2000; Lipponen 2001; Stahl 2002). Yhteisöllisten verkko-oppimisympäristöjen käyttö opetuksen ja oppimisen välineenä on haasteellista, koska verkossa tapahtuva vuorovaikutus on usein tekstipohjaista (Roschelle & Pea 1999). Näin ollen non-verbaalisen viestinnän, kuten kasvojen ja kehon ilmeiden ja eleiden, osuus on minimaalinen. Tämä vaikeuttaa yhteisen perustan rakentamista ja ylläpitämistä, yhteisistä tavoitteista sopimista ja niihin sitoutumista kasvattaen näin osaltaan osallistujien välistä sosiaalista etäisyyttä. On myös todettu, että vapaamuotoinen keskustelu ei palvele oppimista edistävää yhteisöllistä toimintaa (Dillenbourg 2002). Näyttää siis olevan useita tekijöitä, joita joudutaan ottamaan huomioon käytettäessä verkkoympäristöjä tuottavan vuorovaikutuksen ja oppimisen välineenä.

Onnistuneen vuorovaikutuksen ja yhteisöllisen toiminnan edellytys on, että eri osapuolet saavuttavat *yhteisen perustan* (engl. *common ground*) niin sisällön kuin toiminnankin tasolla (Barron 2003; Clark & Schaefer 1989; Dillenbourg 1999). *Rakentaessaan ja ylläpitäessään yhteistä perustaa* yksilöt jakavat ajatuksiaan, olettamuksiaan, uskomuksiaan ja tavoitteitaan interaktiivisessa prosessissa (engl. *grounding*, Clark & Schaefer 1989; Clark & Brennan 1991; Baker ym. 1999). Tässä tutkimuksessa yhteinen perusta nähdään siten, että yhteinen ymmärrys rakentuu ryhmän jäsenten yhteisten toimintojen kautta niin sisällön kuin toiminnan tasoilla. Tämä edellyttää myös sitä, että ryhmän jäsenet tulevat tietoisiksi ryhmän yhteisistä tavoitteista yhteisöllisen oppimisen tilanteissa. Monet tutkijat ovat viitanneet yhteiseen perustaan käyttämällä termejä jaettu ymmärrys (engl. *shared understanding*), jaettu tieto (engl. *shared knowledge*), jaettu merkitysten rakentaminen (engl. *shared meaning-making*) tai ryhmäkognitio (engl. *group cognition*) (mm. Baker ym. 1999; Beers ym. 2005; Dillenbourg & Traum 1999; Jeong & Chi 1997; Mulder, 2004; Stahl 2002; 2005). Aikaisemmat tutkimukset ovat lähestyneet yhteisen perustan synty- ja ylläpitämisen prosesseja lähinnä kognitiivisesta näkökulmasta, mutta tutkittaessa yhteisöllistä toimintaa täytyy ottaa huomioon myös sosio-emotionaaliset ja situationaaliset tekijät. Aikaisempien, kasvokkain tapahtuvia vuorovaikutustilanteita tarkastelleiden tutkimusten perusteella tiedetään, että kun osallistujat kokevat epävarmuutta, he usein kommunikoiivat vähemmän toistensa kanssa saavuttaakseen jaetut tavoitteet (Berger & Bradac 1985). Verkkoympäristöissä epävarmuutta esiintyy silloin, kun osallistujat eivät saa välitöntä palautetta viesteihinsä: Kuinka muut reagoivat heidän viesteihinsä? Ovatko he samaa vai eri mieltä ehdotuksista? Kuinka heidän tulisi organisoida työnsä? Osallistujat voivat olla myös epävarmoja omien viesti-

ensä sisällön laadusta: Onko minun viestini tarkoituksenmukainen aiheeseen nähden? Ymmärtävätkö kanssaosallistujat viestini sisällön? (Mäkitalo ym. 2003.) Yhteinen perusta rakentuu siis tehokkaassa vuorovaikutusprosessissa. Jotta verkossa osallistujat sitoutuisivat yhteiseen toimintaan ja oppimista edistävään vuorovaikutukseen, täytyy yhteisen perustan rakentamiseen ja sen ylläpitämiseen sekä osallistujien yhteisöön kuulumisen tunteen kasvattamiseen kiinnittää tietoista huomiota.

Viime aikoina yhteisöllistä oppimista ja vuorovaikutusta verkossa on pyritty edistämään tarjoamalla opiskelijoiden käyttöön *yhteisöllisiä skriptejä* (engl. *collaboration scripts*), joilla voidaan ohjata ja tukea yhteisöllistä oppimistoimintaa opiskelijoiden kesken (Dillenbourg 2002; Kollar ym. 2003; Weinberger 2003). Yhteisölliset skriptit muodostuvat säännöistä, jotka ohjaavat opiskelijoita kommunikoimaan ja toimimaan yhdessä tehtävää ratkaistaessa (O'Donnell 1999). Skriptien tarkoituksena on auttaa opiskelijoita käyttämään ja omaksumaan sellaisia yhteisöllisen oppimisen toimintoja, jotka edistäisivät yhteistä tiedon rakentamista. Skriptien avulla voidaan tukea oppimista edistävää vuorovaikutusta ohjaamalla opiskelijat sitoutumaan yhteiseen toimintaan samanaikaisesti. Skriptien välityksellä voidaan ohjata toimintaa myös siten, että kaikki opiskelijat suorittavat tietyn toiminnan vuorollaan tai tiettyjä toimintoja sarjassa ennalta määrätyllä tavalla. Yhteisöllisissä verkko-oppimistilanteissa skriptit voivat olla tekstipohjaisia ohjeita ja vihjeitä (engl. *prompts*), joita on rakennettu verkkoympäristöön suullisten ohjeiden tilalle ja jotka ohjaavat opiskelijoita tehtävän ratkaisemiseen yhdessä. (Weinberger 2003.) Skriptejä voidaan rakentaa palvelemaan erilaisia yhteisöllisen toiminnan ja oppimisen tavoitteita. *Sisältösuuntautuneet skriptit* (engl. *epistemic scripts*) voivat esimerkiksi edistää kognitiivisia prosesseja yhteisöllisissä oppimistilanteissa tarjoamalla opiskelijoille ohjeita ja vinkkejä tehtävän ratkaisemisessa. Tämänkaltaiset skriptit voivat auttaa opiskelijoita rakentamaan ja ylläpitämään yhteisesti jaettuun käsitteitä ja kriittisesti pohtimaan ongelmaa tai tehtävää useammasta näkökulmasta (Weinberger 2003).

Tutkimus koostuu viidestä osatutkimuksesta, joissa tarkasteltiin vuorovaikutusta ja oppimista teknologisesti tuetuissa yhteisöllisissä oppimisympäristöissä. Erityisesti vuorovaikutuksellisia prosesseja tarkastelemalla tutkittiin, minkälaisia yhteisen perustan synty- ja ylläpitämisen mekanismeja esiintyi yhteisöllisissä vuorovaikutustilanteissa (Osatutkimukset I-III) sekä miten osallistujat rakensivat ja ylläpitivät yhteistä perustaa ryhmän tavoitteista, toiminnasta ja opittavan aineen sisällöstä (Osatutkimus IV). Tavoitteena oli myös tutkia, voidaanko sisältösuuntautuneen skriptin avulla vähentää epävarmuutta opiskelijoiden välillä ja näin vaikuttaa opiskelijoiden väliseen vuorovaikutukseen ja yksilölliseen oppimiseen (Osatutkimus V). Lisäksi näiden osatutkimusten pohjalta rakennettiin teoreettista mallia, jonka tarkoituksena on lisätä ymmärrystä vuorovaikutuksesta ja yhteisöllisestä oppimisesta verkkopohjaisissa oppimisympäristöissä.

Metodit

Kaikki viisi osatutkimusta toteutettiin korkeakoulukonteksteissa. Osatutkimukset I-IV toteutettiin autenttisissa opettajankoulutuskonteksteissa, kun taas osatutkimus V suoritettiin kontrolloidussa kokeellisessa kontekstissa. Neljässä ensimmäisessä osatutkimuksessa opiskelijat määrittivät itse tiettyjen teemojen puitteissa omat kiinnostuksen kohteensa, jotka liittyivät opettamiseen ja oppimiseen, ja työskentelivät näiden aiheiden parissa. Viidennes osatutkimuksessa tutkijat määrittivät tehtävät sekä suunnittelivat autenttiset tapauskuvaukset liittyen oppimiseen ja oppimista selittäviin tekijöihin.

Kaksi ensimmäistä tutkimusta toteutettiin vuonna 2000 SHAPE-projektissa, jossa opettajaksi opiskelevat osallistuivat opettajankoulutukseen kuuluvalla valinnaiskursille. Ensimmäisessä osatutkimuksessa osallistujia oli yhteensä 116. He olivat Indianan yliopistosta USA:sta (n=67), Warwickin yliopistosta Iso-Britanniasta (n=9) ja Jyväskylän (n=19) sekä Oulun (n=21) yliopistoista Suomesta. Toisessa osatutkimuksessa osallistujia oli yhteensä 68. Opiskelijat tulivat Indianan (n=35), Jyväskylän (n=12) ja Oulun (n=21) yliopistoista. Seitsemän yliopisto-opettajaa toimi mentoreina, ja he tulivat Indianan (n=1), Jyväskylän (n=2) ja Oulun (n=4) yliopistoista. Opiskelijat olivat suorittaneet osan opetusharjoittelusta, ja kaikilla oli perustietämys tietokoneen ja Internetin käytöstä. Kahden kuukauden mittaisella kurssilla opiskelijat kommunikoivat toistensa kanssa käyttäen eriaikaista (asynkronista) keskustelufoorumia ProTo-nimisessä verkko-oppimisympäristössä. Opiskelijat suunnittelivat ja kirjoittivat autenttiset tapauskuvaukset heitä askarruttavista asioista, jotka liittyivät mm. oppimisympäristöihin, teknologian käyttöön opetuksessa ja opettajan ammatilliseen kasvuun. Heidän tehtävänään oli pitää yllä oman tapauskuvauksen keskustelua sekä tehdä yhteenveto käydystä keskustelusta kurssin puolivälissä ja sen lopussa. Opiskelijoiden tuli käydä verkkoympäristössä vähintään kerran viikossa.

Kolmas ja neljäs osatutkimus toteutettiin vuonna 2002 jälleen osana SHAPE-projektia. Osatutkimuksiin osallistuva pienryhmä valittiin kuudesta ryhmästä, ja siinä oli kolme englanninopettajaksi opiskelevaa Jyväskylän (n=2) ja Oulun (n=1) yliopistoista. Tämä ryhmä valittiin, koska se oli ainoa ryhmä, joka työskenteli pääasiallisesti verkkoympäristössä ja jossa oli opiskelijoita molemmista yliopistoista. Kaikki kolme opiskelijaa hallitsivat tietokoneen ja Internetin käytön perusteet. Jyväskylän yliopiston opiskelijat tunsivat toisensa entuudestaan, mutta oululainen opiskelija ei tuntenut kumpaakaan. Opiskelijoiden tehtävänä oli löytää yhteinen kiinnostuksen kohde kulttuurin ja kommunikaation alueelta sekä työskennellä yhteisen tutkimusprojektin parissa. Opiskelijoita ohjeistettiin käymään verkko-oppimisympäristössä vähintään kerran viikossa. Kahden kuukauden mittaisen kurssin lopussa jokainen ryhmä esitteli oman lopputyönsä Oulun ja Jyväskylän välisessä videokonferenssissa.

Viides osatutkimus toteutettiin Münchenin yliopistossa Saksassa. Satunnaisesti muodostetut kolmen hengen ryhmät (n=16) jaettiin satunnaisesti uudelleen kahteen koeryhmään, ohjattuun ja ei-ohjattuun ryhmään. Ensimmäisessä koeryhmässä opiskelijoiden yhteisöllistä oppimistoimintaa ohjattiin sisältösuuntautuneen skriptin avulla, kun taas toiselle koeryhmälle ei tarjottu mitään ohjausta ja tukea tehtävän tekemiseen. Molemmissa koeryhmissä tehtävä oli määritelty saman ajan puitteissa suoritettavaksi. Eri huoneisiin sijoitetut opiskelijat kommunikoivat verkkoympäristön välityksellä toistensa kanssa. Opiskelijoiden tehtävänä oli ratkaista kolme autenttista ongelmatehtävää soveltamalla Weinerin (1985) attribuutioteoriaa. Opiskelijat analysoivat ja keskustelivat tehtävistä keskustelufoorumien välityksellä. Sisältösuuntautuneessa skriptiryhmässä verkkoympäristön viestilaatikkoon automaattisesti tulevat vihjeet sisälsivät kysymyksiä ja ehdotuksia tehtävän ratkaisemiseksi. Vihjeiden tarkoituksena oli auttaa opiskelijoita huomioimaan olennainen tieto ja attribuutioteorian keskeisimmät käsitteet tehtäviä ratkaistaessa. Verrattuna edellisiin osatutkimuksiin (I–IV), tämän osatutkimuksen konteksti erosi muista siinä, että yhteisöllinen toiminta kesti 80 minuuttia (muissa kaksi kuukautta) ja vuorovaikutus oli enimmäkseen samanaikaisesti tapahtuvaa, koska opiskelijat olivat yhtä aikaa verkko-oppimisympäristössä.

Kaikissa osatutkimuksissa pääasiallinen tutkimusaineisto oli verkkokeskusteluaineisto. Eri osatutkimuksissa hyödynnettiin myös muita yksilöiden ja ryhmien tuottamia dokumentteja, kuten päiväkirjamerkintöjä, yhteenvetoja, oppimistulosta mittaavia tehtäviä sekä tilastollisia lokiaineistoja. Kaikissa osatutkimuksissa käytettiin laadullisia lähestymistapoja, mutta tämän lisäksi osatutkimuksissa I, II ja V hyödynnettiin myös määrällisiä analyysitapoja. Laadullisissa analyyseissä käytettiin sekä teoria- että aineistolähtöistä lähestymistapaa.

Tulokset ja johtopäätökset

Menestyksekkään vuorovaikutuksen ja yhteisöllisen toiminnan kannalta on tärkeää, että osallistujat sitoutuvat ja osallistuvat tasavertaisesti yhteisölliseen toimintaan jakaessaan toistensa kanssa tietoa, olettamuksia, uskomuksia, kokemuksia ja tunteita. Vuorovaikutusprosessissa yhteisen perustan rakentamis- ja ylläpitämismekanismit ovat peruselementtejä, joiden olemassa olo voi lisätä, mutta puuttuminen myös estää, yhteisen ymmärryksen saavuttamista tai osallistujien toimimista ryhmänä meneillään olevassa yhteisöllisessä oppimistilanteessa. Vuorovaikutusprosesseissa osallistujat kohtaavat rinnakkaisen ongelmatilanteen sekä sisältö- että toimintatasolla rakentaessaan ja ylläpitäessään yhteistä perustaa. Opiskelijoiden täytyy kiinnittää huomiota sisältöön ymmärtääkseen, mitä kanssoppijat sanovat ja mitä tai miten jotain voi toiselle sanoa, jotta ei syntyisi sekaannuksia ja

väärinymmärryksiä. Yhteisöllisen toiminnan tasolla opiskelijoiden tulisi ymmärtää, mitä kanssaopiskelijat voivat tehdä ja mitä he haluavat tehdä yksilönä ja ryhmänä. Yksilöiden täytyy kiinnittää huomiota siihen, haluavatko ja ovatko kanssaosallistujat kykeneviä mahdollisuuksien mukaan kirjautumaan verkkoympäristöön ja kuinka useasti. Heidän täytyy myös havaita tärkeät ideat ja ehdotukset ja olla valmiita kuuntelemaan tai toisin sanoen lukemaan tekstipohjaisia viestejä ja reagoimaan niihin. Osallistujien täytyy kyetä myös olemaan läsnä ja näyttämään läsnäolonsa sopivalla tavalla. Tulokset osoittavat, että onnistuakseen yhteisöllisessä toiminnassa opiskelijoiden täytyy panostaa sekä yksilönä että ryhmänä yhteisen perustan rakentamiseen ja ylläpitämiseen sekä sisällön että toiminnan ta- soilla.

Osatutkimukset osoittavat, että rakentamis- ja ylläpitämismekanismeja voidaan käyttää eri tavalla riippuen mm. yhteisöllisen oppimistehtävän luonteesta, osallistujien taustasta ja aikaisemmista suhteista (vertaisryhmä, opiskelija-mentori jne.), yhteisöllisen toiminnan olosuhteista (kasvokkain, verkkopohjainen), asetelmista (luokkahuoneessa, kotona jne.) tai pituudesta (tunteja, päiviä, kuukausia) ja kommunikaation luonteesta (samanai- kainen tai eriaikainen). Näiden eri tekijöiden vaikutuksia mekanismien käyttöön tulisi kuitenkin tutkia enemmän. Näyttäisi siltä, että loppujen lopuksi opiskelija itse määrittelee, kuinka paljon tai vähän ponnisteluja hän on valmis tekemään rakentaakseen ja ylläpitääkseen yhteistä perustaa muiden opiskelijoiden kanssa. Tähän voi vaikuttaa esimerkiksi se, kuinka paljon opiskelija voi käyttää aikaa tiettyyn opintokokonaisuuteen, millaiset oppi- mistavoitteet hän on itselleen asettanut, onko hän sitoutunut ryhmän yhtenäisiin tavoittei- siin, minkälaiset verkkoyhteydet ovat käytössä, kuinka mielekästä ryhmätyöskentely on kyseisessä ryhmässä ja niin edelleen. Nämä asiat tulisi huomioida myös silloin, kun yhtei- sen perustan syntymisen ja ylläpitämisen mahdollisuuksia tarjotaan oppimisympäristöjen kautta (esim. skriptit; ks. myös Pfister 2005).

Verkkokurssi, jossa osallistujat eivät tunne toisiaan, voi lisätä epävarmuutta osallistujien välillä, ja siten vaikuttaa yhteisölliseen toimintaan monin tavoin. Opiskelijoiden vuorovaik- kutusta ja yhteisöllistä toimintaa voidaan edesauttaa tukemalla ja ohjaamalla niitä skripti- en avulla. Tulokset tukevat sitä ideaa, että sisältöön kohdistuva ohjaus ja tuki vähentävät epävarmuutta. Tulokset osoittavat kuitenkin myös sen, että ei-tuetuissa olosuhteissa työskentelevät opiskelijat saavuttivat paremmat oppimistulokset kuin ohjatuissa ja tuetuissa olosuhteissa työskentelevät. Näin ollen voidaan ajatella, että epävarmuus edistää myös hyö- dyllisiä vuorovaikutusmuotoja kuten tiedonetsintäprosesseja. Toisaalta menestyksensä ryhmässä työskennelleet ponnistelivat tehokkaammin rakentaessaan ja ylläpitäessään yh- teistä perustaa tavoitteista, toiminnasta ja sisällöistä. Skriptit voivat joko edistää tai rajoittaa vuorovaikutusta ja yhteisöllistä toimintaa sekä oppimista osallistujien kesken. On kuiten- kin ilmeistä, että tarvitaan lisää tutkimusta siitä, kuinka paljon opiskelijat tarvitsevat va- pautta ja toisaalta tukea yhteisöllisen oppimisen verkko-oppimisympäristöissä.

Tämän väitöskirjan osatutkimusten pohjalta rakennettiin teoreettinen malli soveltaen Joharin ikkunateoriaa (Luft, 1984; Chapman 1995-2005), johon yhdistettiin yhteisen perustan viitekehystä ja sen rakentamis- ja ylläpitämismekanismeja sekä epävarmuuden vähentämisen strategioita. Tämän mallin tarkoituksena on ymmärtää syvemmin yhteisen perustan rakentamisen prosessiin liittyviä merkittäviä alueita, joiksi tässä tutkimuksessa määriteltiin seuraavat neljä aluetta: *yhteisen perustan alue* (engl. *area of common ground*), *vältetty tai salattu alue* (engl. *avoided/hidden area*), *sokea alue* (engl. *blind area*) ja *ei-tunnettu alue* (engl. *unknown area/no common ground*). Näihin alueisiin tulisi kiinnittää huomiota verkko-oppimisympäristöissä sekä tutkimuksen että pedagogiikan näkökulmasta. Yhteisen perustan synty- ja ylläpitämismekanismit sekä epävarmuuden vähentämisen strategiat sekä skriptit voivat auttaa opiskelijoita siirtymään yhteisen perustan alueelle, mikä puolestaan mahdollistaa rakentavan ja tehokkaan kommunikaation ja yhteisöllisen toiminnan. Mallissa yhdistyvät sekä sisältö- että toimintatasot. Mallin perusteella ehdotetaan, että verkko-vuorovaikutusta tutkittaessa pitäisi kiinnittää entistä enemmän huomiota yhteisen perustan vuorovaikutusprosessien piilotettuihin alueisiin, jolloin voitaisiin selvittää paremmin, miksi ja miten yksilöt ja ryhmät tietyssä tilanteessa toimivat.

Näyttää siltä, että opiskelijat, joiden huomio on yhteisesti kiinnittynyt tehtävään tai ongelmanratkaisuun ja jotka ovat sitoutuneet tähän prosessiin ja ponnistelevat rakentaakseen ja ylläpitääkseen yhteistä perustaa, oppisivat myös tehokkaammin (ks. Barron, 2003). Osallistumisen määrä ei sinänsä näyttäisi edistävän oppimista vaan osallistumisen laatu, kuten esimerkiksi toisten ideoiden ja ehdotusten kuunteleminen ja niiden huomioiminen sekä uusien näkökulmien esittäminen, pohtiminen ja kehittäminen yhdessä. Ryhmän yhteenkuuluvuudelle ja avoimen ilmapiirin luomiselle näyttäisi olevan tärkeää, että opiskelijat tukevat ja kannustavat toisiaan. Yhteisöllinen toiminta on siis enemmän kuin sisällön oppimista, se on myös oppimista yhteisölliseen toimintaan. Vaikka opiskelijoita nykyisin pyritään ohjaamaan yhteisölliseen oppimiseen erilaisin teknologisin apuvälinein, niin parhaimmillakaan apuvälineillä ei välttämättä saavuteta niitä oppimistavoitteita, joita suunnittelijat, tutkijat ja opettajat ovat asettaneet. Opiskelijat saattavat olla kykenemättömiä käyttämään työvälineitä menestyksekkäästi ilman ohjausta, jos yhteisöllisen toiminnan ja oppimisen perussäännöt ovat epäselviä. Oppimisen arvioinnissa tulisi kiinnittää huomiota yhä enemmän prosessin arviointiin, koska vallitseva käsitys yhteisöllisestä oppimisesta on, että se tapahtuu ryhmän vuorovaikutusprosessissa (Koschmann ym. 2005; Stahl 2005). Ohjattaessa opiskelijoita itse arvioimaan ryhmänsä prosessia, he voivat parhaimmillaan sisäistää ajatuksen siitä, mikä on arvokasta ja välttämätöntä yhteisöllisessä toiminnassa. Näin ollen he siirtyvät myös käyttämään näitä mekanismeja ja tapoja yhteisessä työskentelyssä, mikä puolestaan vie ryhmän ja yksilöiden oppimista eteenpäin. Opiskelijat oppivat arvioimaan omaa panostaan ja ryhmän jäsenten osuutta sekä ryhmän yhteistä osuutta yhteisöllisen oppimisen toiminnassa. Tämän avulla he oppivat myös kehittämään

omaa ja ryhmän työskentelyä tavoitteiden mukaisesti. Näyttää siltä, että opiskelijat oppivat erilaisia asioita siitä huolimatta, että he ovat samassa ryhmässä ratkaisemassa samanlaisia tehtäviä. Siksi yksilön kokemukset omasta oppimisestaan ovat myös tärkeitä oppimisen mittaamista suunniteltaessa.

Tutkimuksen metodologinen anti osoittaa, että yhteisöllisen oppimisen tutkimisessa tulisi kehittää yhä enemmän sellaisia lähestymistapoja, joissa hyödynnetään sekä määrällisiä että laadullisia menetelmiä. Määrällinen lähestymistapa perustuu yleensä vahvaan teoreettiseen viitekehykseen, jolloin voidaan tutkia aikaisemman teoreettisen tiedon perustalta luotuja oppimistilanteita. Tämän kaltainen lähestymistapa jättää huomioimatta ryhmän vuorovaikutukseen ja yhteisölliseen toimintaan vaikuttavat tilannetekijät. Nämä tekijät voidaan kuitenkin ottaa huomioon käyttämällä laadullisia analysointimenetelmiä.

Tämän tutkimuksen tuloksista ei voida esittää yleistyksiä, koska tutkimusjoukot olivat pieniä. Kuitenkin eri osatutkimuksen tulokset tukevat toisiaan, joten voimme saada viitteitä siitä, millaiset mekanismit edesauttavat yhteisen perustan syntyä ja ylläpitämistä verkkoympäristöissä. Näitä mekanismeja tulisi kuitenkin tutkia laajemmassa tutkimusjoukossa, jotta nähdään, mitkä mekanismit nousevat tärkeimmiksi tekijöiksi yhteisen perustan rakentamisessa ja ylläpitämisessä. Tukea antava ja myönteinen palaute on jo todettu merkittäväksi tekijäksi yhteisöllisen oppimisen tilanteissa. Tärkeää olisikin kannustaa opiskelijoita tämänkaltaisen palautteen antamiseen sekä pohdiskelevien ja kriittisten kysymysten esittämiseen, niihin vastaamiseen sekä saadun tiedon hyödyntämiseen. Erimielisyyksiä ja tiedon kriittistä pohdiskelua esiintyi verkkokeskusteluissa harvoin, mikä osoittaa sen, että kouluissa ja yliopistoissa vallitsee sellainen keskustelu- ja toimintakulttuuri, joka ei palvele yhteisöllisen oppimisen toimintamuotoa (ks. Kanuka 2005; Mandl ym. 1996). Skriptein tuetut oppimisympäristöt voisivat tarjota välineen toisenlaisen toimintakulttuurin omaksumiseen, mikä auttaisi opiskelijoita sisäistämään yhteisöllisen oppimisen toimintatapoja ja käyttämään niitä myös muissa luokkahuoneen ulkopuolisissa tilanteissa.

Positiivisten oppimiskokemusten tarjoaminen opettajankoulutuksessa oleville opiskelijoille ja täydennyskoulutuksessa oleville opettajille olisi tärkeää, jotta he olisivat valmiimpia hyödyntämään tieto- ja viestintäteknologiaa ja yhteisöllisen oppimisen menetelmiä opetuksessaan. Sekä opettajien perus- että täydennyskoulutuksessa tulisi yhä enenevässä määrin kiinnittää huomiota tieto- ja viestintäteknologian käytön pedagogiseen puoleen ja tarjota kaikille opettajille mahdollisuus osallistua sellaisille kursseille, joissa he pääsisivät kokeilemaan teknologian käyttöä oman oppimisensa kannalta. Omien kokemustensa pohjalta he saisivat tuntuman siihen, millaista verkkovuorovaikutus ja yhteisöllinen oppiminen voi olla. Näin ollen opettajat myös pystyisivät paremmin ohjaamaan ja tukemaan oppilaitaan tämänkaltaisissa tilanteissa. Uusien innovatiivisten käytänteiden omaksuminen edellyttää Stahlin (2005) mukaan sitä, että sekä opettajien että tutkijoiden tulisi ymmärtää paremmin oppimista ryhmän näkökulmasta. Yhteisöllisen oppimisen mahdollisuus on

juuri siinä, että ryhmät voivat todellakin rakentaa tietoa yhdessä sillä tavalla, joka on mahdotonta yksittäisille oppilaille. Ryhmässä oppiminen edistää parhaimmillaan myös yksilön oppimista. Verkkovuorovaikutus ja tiedon rakentaminen yhteisöllisesti voi luoda uudenlaisia oppimiskulttuureja. Niiden siirrettävyys vallitsevaan toimintakulttuuriin on kuitenkin haasteellista ja edellyttää opettajien ja tutkijoiden pitkäjänteistä yhteistyötä tieto- ja viestintäteknologian opetuskäytön alueella.

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Collaboration promoted and supported by instructional technology has the potential to lead learners to deeper understanding and knowledge building. There have been optimistic views that any web-based interaction can be educationally valuable. However, online learning environments do not, as such, guarantee that learners will achieve genuine collaboration. It seems that there are several difficulties facing those who wish to employ online learning environments as a medium for productive learner interaction.



The particular aim of this exploration of interaction and learning in computer-supported collaborative learning environments was to study the interplay between learners and consider the ways in which they built and maintained common ground so as to enable themselves to work and learn together. Another aim was to look at the effects of scripting interaction in online learning environments with a view to finding out how scripting can enhance or hamper collaboration.



The study opens up a perspective on online communication as a distinctive type of human interchange whose special features challenge designers, researchers, teachers and learners involved in computer-supported collaborative learning.