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SHARING AND CONSTRUCTING PERSPECTIVES IN WEB-BASED CONFERENCING

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Abstract

This study investigates the quality and nature of virtual interaction in a higher education context. The study aims to find out variables that mediate virtual interaction, particularly the emerging processes of sharing and constructing perspectives in web-based conferencing. The purpose of this paper is to report the results on different levels of web-based discussions

with parallel findings on the amount of sharing perspectives. The findings of two empirical studies are compared, and therefore, also the impact of the pedagogical model designed between these two studies is evaluated. Possible explanations for why some discussions reach higher levels and include more perspective sharing than others are also searched for. The particular emphasis is paid to the qualitatively distinct ways in which individual students interpret their participation in virtual interaction and the impact of group working to their own learning. These findings lead us to discuss on specific processes by which participants could better understand each other, create joint goals and construct meanings in virtual interaction.

Keywords: computer-mediated communication, cooperative/collaborative learning, learning communities, pedagogical issues.

Introduction

One of the essential requirements in the rapidly changing society is to prepare learners for participation in socially organized activities. Pure focus on individual cognition has set a stage to shared, interactive and social construction of knowledge (Greeno, 1998), and new learning environments are often based on collaborating and sharing expertise (Koschmann, 1996). Recent emphasis on studying in higher education (e.g. Virtual University) and working in companies (e.g. distributed global team work) clearly set demands for developing

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pedagogical models, tools and practices to support collaborative learning in virtual environments. Empirical studies and theoretical considerations indicate that collaborative learning seems to provide a relevant theoretical basis for web-based and networked models of learning (Crook, 1994; Dillenbourg, 1999; Hakkarainen, Järvelä, Lipponen & Lehtinen, 1998; Koschmann, 1996; Scardamalia & Bereiter, 1996; Wilson, 1996).

Our own studies indicate that the quality of meaningful web-based interaction and learning varies a lot (Järvelä & Häkkinen, 2002, 2003; Saarenkunnans, Järvelä, Häkkinen, Kuure, Taalas, & Kunelius, 2000). To conclude, collaborative processes are often over-generalized, and any tools for communication and correspondence are called 'collaboration tools' (Roschelle & Pea, 1999). The problem is that if almost any interaction situation is called collaborative, it is difficult to judge whether and when people learn from collaborative situations (Dillenbourg, 1999; Littleton & Häkkinen, 1999).

Issues of collaborative learning

Research results of computer support for collaborative learning have been contradictory, and several studies have indicated collaborative learning to be far more complex phenomenon and difficult to realize in real-life settings than what has often been thought (Baker, 2002; Häkkinen, 2001). In many of the studies demonstrating positive effects of social interaction for individual learning (Light, Littleton, Messer & Joiner, 1994), collaborative learning has been interpreted as a single learning mechanism. Researchers also tried to control several independent variables, which interacted with one another in a way that made it difficult to

establish causal links between the conditions and the effects of collaboration (Dillenbourg, Baker, Blaye & O'Malley, 1995). In contrast, research trends of collaborative learning have started to focus on particular processes and mechanisms that either support or constrain co-construction of knowledge. Recent research on collaborative learning has also called for more exact use of terminology related to the specific forms of collaboration. Collaborating participants learn if they generate certain collaborative activities, which trigger particular kinds of learning mechanisms. Collaborative learning situations can, for example, provide a natural setting for demanding cognitive activities such as explanation, argumentation, inquiry process, mutual regulation etc., which further on can trigger collaborative learning mechanisms such as knowledge articulation as well as sharing and distributing cognitive load (Dillenbourg, 1999).

Typical features for collaborative interaction in networked environments are short discussion threads as well as descriptive and surface-level knowledge instead of finding deeper explanations for the phenomena under study (Järvelä & Häkkinen, 2002). It has also proved to be difficult to generalize knowledge approached from multiple perspectives (Schwarz, 1995). One of the most crucial problems related to the process of collaboration is the difficulty in making inquiry questions that would evoke elaborated explanations (Scardamalia & Bereiter, 1996).

Particular challenges are also related to reaching of reciprocal understanding, shared values and goals in between the participants in networked environments (Fischer & Mandl, 2001; Häkkinen & Järvelä, 2002). New kind of learning environments are produced for shared problem solving and enhanced interpersonal interaction by computer-mediated

communications due to the lack of nonverbal communication, greater individual involvement and new kind of turn-taking skills required by networked environments (Salaberry, 1996). Asynchronous interaction without immediate social contact has many challenges to overcome since communicating parties are faced continuously with the task of constructing their common cognitive environment. Furthermore, numerous studies report on perspective-taking, reciprocal understanding, negotiation of joint goals and grounding as well as on the dynamics of power and distance in synchronous communication (Fischer & Mandl, 2001; Salaberry, 1996).

Theories on social interaction and learning (Doise & Mugny, 1984; Markova, Grauman & Foppa, 1995) have given insight on the specific processes of human interaction as negotiation of meaning. Social negotiations are typical components of collaborative interaction, and through them, common goals are constructed. Common goals form the basis for joint work, and negotiation of common goals is part of the interactive process of grounding. Building and maintaining a common ground means that individuals construct shared understanding, knowledge, beliefs, assumptions and pre-suppositions (Brennan, 1998; Clark & Schaefer, 1989).

One of the common method in CSCL research deals with analyzing the patterns of participation and discourse (Hewitt & Tevlops, 1999; Lipponen, 2001). However, the method does not usually reveal what makes some participants of virtual learning community more active and productive, while others take part in virtual interaction at long intervals. It seems evident that people acquire knowledge and patterns of reasoning from one another but for some kinds of shared knowledge, individually rooted processes play a central role

(Resnick, Levine & Teasley, 1991). It is also clear that individuals have qualitatively different ways to participate in learning communities (Cobb & Bowers, 1999). Therefore, in addition to the analysis of participation as quantitative phenomenon or participation structure, it is also important to examine the level of individual students in CSCL settings (Leinonen & Järvelä, 2003). This level of analysis can either focus on assessment of individual learning outcomes or experienced effects and interpretations of participating into community. Our hypothesis is that in order to move to successful web-based learning and virtual interaction in education we need to know more on the basic processes of human interaction and learning, and on how to use that knowledge to promote the quality of virtual interaction in networked technology contexts.

Aims

The purpose of this study is to report the results on the analysis of sharing and constructing perspectives in virtual interaction. The findings of two empirical studies are compared in order to see *whether there are differences in the way the students share the perspectives*. The special aim was to analyse *whether the pedagogical model developed after the first study for the second study made any difference in enhancing perspective sharing*. Possible explanations for why some discussions reached higher levels and more perspective sharing than others were also searched for with the aid of on-line questionnaire focusing on individuals' experiences.

Research design

Subjects

The subjects of the study are pre-service teachers from different countries. In the first study, the students came from the United States (University of Indiana) (N=40) and Finland (N=30). Finnish students came from two different universities: 20 students from the University of Oulu and 10 students from the University of Jyväskylä. In the second study, there were students from the United States, University of Indiana (N=67), from Great Britain, University of Warwick (N=9) and from Finland, University of Jyväskylä (N=19) and University of Oulu (N=21). For all these students, the participation in web-based conferencing course is credited as part of their compulsory studies in education. All the students had experiences with field training, some studies in educational psychology, and basic knowledge about computers and Internet. The web-based projects lasted two months in the first study and three months in the second study.

Task and tools

The learning task was to construct case-based descriptions in the areas such as learning context or technology in education as well as the change these practices impose on the traditional teaching and learning practices. Each case could have been either a success story or a description of a problematic teaching scenario based on fieldwork observations of 'theory in action'. For example, students were asked to describe a teacher and/or student(s) in a problematic or instructionally interesting situation observed in the field;

leaving all the names and places of the situation anonymous. Different levels of expertise in peer and mentor collaboration were provided during the learning process in order to apprentice student learning. Mentoring was organized by senior students in other countries as well as by in-service teachers and faculty members from other universities. Students used different asynchronous web-based learning environments for this case-based work. In the first study they used shareware conferencing system called COW (Conferencing on the Web), and in the second study they used Proto environment developed in the University of Oulu. In order to strengthen the feeling of a virtual community, the web-work was supported by videoconferences between different sites. In these conferences, the process of creating cases was discussed (See Saarenkunnas et al., 2000).

Method

Data collection

A combination of quantitative and qualitative research methods were employed. Quantitative data included: 1) computer-generated usage of statistics that illuminate the nature, time and volume of participation (the amount of messages, replays, frequencies etc.), as well as the distribution of discussions among the users; 2) transcript data of students messages, and 3) on-line questionnaires repeated three times during the course and focusing on individual interpretations.

Data analysis

Three phases related to the analysis of discussion data were similar in both of our studies, whereas the on-line questionnaire was used only in the second study. At first, the preliminary analysis of each discussion was conducted and the types of messages were grouped into the following categorizations: Theory / New point, Question / Experience / Suggestion / Comment. After that cross-references between the student messages within discussions, and mentors' messages were marked. Moreover quantifications were made such as, the number of messages by mentors, the number of each type of message and the number of cross-references.

The second phase of the analysis focused on the level of discussions. Graphs were drawn, which demonstrate the progress of a discussion, dynamics of different types of messages, mentors' role and cross-referring in each discussion. The graphs were researchers' analytic tools, which facilitated formulating three groups of all the discussions: high-level discussions, progressive discussions and low-level discussions. Two researchers made independent estimates of levels of discussions. Their classifications matched perfectly with 80-95 % of codings. The contradictory analyses were negotiated until unitary estimation was reached.

In the third phase, the specific analysis of a quality of communication in terms of perspective sharing was made. Based on Piaget's cognitive developmental theory, Selman (1980) has outlined a social cognitive developmental model of five distinct stages with increasing abilities to take into account alternative viewpoints. The developmental levels of the co-ordination of social perspectives are: Stage 0: Undifferentiated and Egocentric, Stage 1: Differentiated and Subjective Role-Taking; Stage 2: Self-Reflective/Second

Person and Reciprocal Perspective, Stage 3: Third-Person and Mutual Perspective Taking, and Stage 4: In-depth and Societal-Symbolic Perspective Taking. The analysis category and the analysis procedure have been described in details in Järvelä & Häkkinen (2003).

In order to capture the qualitatively different ways in which students experienced the effects of and prerequisites for collaborative learning we analyzed the on-line questionnaire that was repeated three times during the on-line course of the second study. The aim of this questionnaire was to give the participants a possibility to express their interpretations and experienced effects of working in the on-line learning community. The questions of the questionnaire were the following: (1) How does group working facilitate learning in general?, (2) How does group working facilitate my own learning in particular?, and (3) What kind of impact do my own activities have on group performance? (Häkkinen & Järvelä, 2001). With the aid of the analysis of multiple-choice questions and content analysis (Chi, 1997) of open questions, the experienced effects were evaluated.

Results

The following results have been gained from the series of design experiments in the two of our studies. The first study was conducted in Spring 1998 and the second one in Spring 2000. Between the two studies, the following pedagogical model was developed. The model was a consequence of the analysis of the study 1 since the results pointed out serious problems in the perspective sharing between the students.

Pedagogical model

Following the principles of interventions studies in authentic context (Brown 1992) we developed a pedagogical model supporting the interactors' perspective sharing in web-based learning. The pedagogical model was based on our previous studies on networked interaction and case-based model in conferencing on a web (Järvelä & Häkkinen, 2003; Saarenkunnas et al., 2000). In terms of designing pedagogical implications to enhance high-quality virtual interaction we emphasized the following principles.

1. Problem-oriented case-work was established (Scardamalia & Bereiter, 1996). Students had to redefine the original problem as well as to summarise and to reflect the discussion during the course.
2. Group reflection was promoted by metawork (Häkkinen, Järvelä & Dillenbourg, 2000). The students' awareness of individual and group processes in the virtual community was raised with on-line web-questionnaires.
3. Awareness of perspective sharing and negotiation of joint goals was supported by participant observation (Silverman, 1993). The role of face-to-face meetings was essential for the grounding process throughout the course.

Types of messages

In the first study, during the 2-month period, the students produced 25 different discussions involving 10 to 30 messages in each discussion. In the second study, during the three months period the students produced 40 different discussions involving 5-25 messages in each discussion.

In the first phase of the data analysis, messages were categorised into five different groups: theory-based messages, new point or question, experience, suggestion and comment. The amount of theory-based messages and new points or questions was higher in the study 2 than in the study 1. In the study 1, 9 % of the messages were theory-based and 20 % new points or questions, whereas 20 % of the messages were theory-based and 44 % new points or questions in the study 2. Compared to the study 1 (45 %), the amount of comments was clearly decreased in the study 2 (6 %). There were also less suggestions in the study 1 (6 %) than in the study 2 (19 %). The amount of experience-based messages was 20 % in the study 1 and 11 % in the study 2. (See the Figure 1.)

INSERT FIGURE 1.

Level of discussion

In order to understand how the students were able to share perspectives and construct collaborative discussion, we focused the analysis on the level of whole virtual discussion. The results indicate improvement in the level of web-based discussion. Especially the amount of high-level discussions was increased and the amount of low-level discussions decreased (see Figure 2). The categorising of discussions into three different groups according to their educational value indicated that 53% of discussions in the study 2 and 24 % in the study 1 were high-level discussions, 42% in the study 2 and 40 % in the study 1 were progressive discussions, and 5% in the study 2 and 36 % in the study 1 were low-level discussions. High–level discussions could be characterised as shared theory-based

discussions involving a lot of theory-based messages as well as new points or questions. Rich cross-referring between messages was also typical. Progressive discussions also involved some cross-references, generalisations and joint knowledge-building but also plenty of comments, experience-based messages and messages with new points or questions. However, no theory-based discussion occurred. Low-level discussions involved mainly separate comments and opinions. Students' comments did not take into consideration the earlier discussion but rather represented each student's independent and often unilateral comments.

INSERT FIGURE 2.

How the perspectives were shared?

Discussions were also analysed trough categories based on the socio-cognitive perspective taking theory. This was meant to illustrate us how the perspectives were shared in web-based discussions. Compared to the Study 1, the results of the study 2 represented higher stages of perspective sharing. Especially the proportion of Mutual Perspective Taking was higher in the second study (71 %) than in the first study (20 %). Mutual Perspective Taking meant that the topic of discussion was seen from the third person or generalized other perspective. The discussion typically progressed from mutual experiences (my points) to more elaborative argumentation, and developed to discussions about more general points in education or society, for example. The stage 2, Reciprocal Perspective Taking occurred in 21 % of the discussions in the study 2 and in 36 % of the discussions in the study 1. These

discussions represented two-way reciprocity in thoughts and feelings, not merely in actions, but different perspectives were not taken into account enough.

In the study 2, one discussion (3 %) also reached highest stage of perspective sharing (Societal-Symbolic Perspective Taking), the stage which did not occur at all in the study 1. Typical for this kind of discussions was that students abstracted multiple mutual perspectives to a societal, conventional, legal or moral perspective, which all the individuals could share. In the study 1, 8 % of the discussions were categorized at the lowest stage (Egocentric), whereas none of the discussions in the Study 2 stayed at this stage. In these discussions, students just presented subjective and egocentric expressions, and messages remained scattered. The lowest stage (stage 1) of perspective taking in study 2 was Subjective Role-Taking (5 %) where students' opinions, experiences and feelings were unitary, and they responded to messages of discussion with alike messages. Subjective Role-Taking was, however, fairly common (36 %) in the study 1.

INSERT FIGURE 3.

Connection between the level of discussion and perspective sharing

In general, the results in both studies indicate that high-level discussions involved communication with highest stage of perspective taking and constructive discussion, while low-level discussions were mostly egocentric and superficial. For example, in this second study, the discussions, which were educationally at the higher level, were either at the stage 4, stage 3 or stage 2. Most of them (18 discussions) were at the stage 3 (Mutual

Perspective Taking). One of the high-level discussions was at the stage 4 (Societal-Symbolic Perspective Taking) and one at the Stage 2 (Reciprocal Perspective Taking). The progressive levels of discussions (16) were either at the stage 3 or at the stage 2. Nine of the discussions were at the Mutual Perspective Taking stage (the stage 3) and seven at the Reciprocal Perspective Taking stage (the stage 2). The low-level discussions (2) stayed at the Subjective Role-taking stage (the stage 1).

Individuals' experienced effects of networked collaboration.

Why do some discussions then reach higher levels and include more perspective sharing than others? What kind of qualitatively distinct interpretations do individual students have about their participation in virtual interaction? The results indicated that the participants had a fairly positive impact of group working for their own learning, but more modest interpretations of their own contribution for the group (see Figures 4 and 5).

INSERT FIGURE 4.

INSERT FIGURE 5.

There were about 2 weeks in between the three on-line questionnaires administered to the students. Even though the virtual course was a relatively short period of time, there can be seen changes in students' experienced effects. Especially the personal meaningfulness of web-based collaboration has been increased (see Figure 4).

The most typical arguments for students' positively experienced effects of

participating in the on-line learning community were grouped into three categories: cognitive achievements, perspective taking and argumentation (Häkkinen & Järvelä, 2001). Third of the students (28 %) mentioned the networked collaboration to facilitate higher-level cognitive achievements by providing a setting for explanation and knowledge articulation. The following quotation is based on the content analysis of open questions, and it illustrates one student's experience of cognitive achievements.

> *"Changing thoughts and ideas with other teacher students broadens my own thinking. Group working remarkably clarifies understanding of given tasks and problems. It facilitates learning when we can handle the possible problems and unclarities in a group." [Finnish female student, pre-service teacher education, University of Oulu]*

The second biggest category of experienced effects (mentioned by 25 % of the students) was related to perspective taking, namely to how human points of view are related and coordinated with one another (Selman, 1980). See the following quotation:

> *"I get a lot of new perspectives and realize that others' viewpoints and thoughts can be very different and even contradictory with my own ones." [Finnish male student, teacher trainee majoring in English philology, University of Jyväskylä]*

Qualitatively different, and a little bit more exceptional way (mentioned by 10 % of the students) to perceive the benefits of networked collaboration was related to the role of cognitive conflict, and particularly to the socially mediated processes of conflict resolution through argumentation (Dillenbourg, 1999). See the following quotation:

> *"When I get a counterargument for my own argument, I immediately have to consider the reliability and persistence of my own perspective. I have to justify my own position." [Finnish male student, pre-service teacher education, University of Oulu]*

Necessary prerequisites for networked collaboration

The analysis of the on-line questionnaire also revealed interpretations concerning the necessary prerequisites for successful networked collaboration. Some of the experienced prerequisites were related to the engagement, commitment and motivational issues (mentioned by 10 % of the students, see the following quotation).

> *"Yes, if an individual is motivated to solve the problem and is committed to outline and solve the problem." [Finnish male student, pre-service teacher education, University of Oulu]*

A common prerequisite was also related to the individual responsibility and efforts made by students themselves (see the following quotation).

> *"Responsibility for my part of the work also makes me work harder because I don't want to let the others down. It also depends on my own activeness as a director of my own case and as a commentator of others' cases." [Finnish female student, teacher trainee majoring in English philology, University of Jyväskylä]*

The adequate use of methods revealing individuals' personal experiences and interpretations can act as one of the main methodological approaches. However, in our studies we used this method to support and complement the methods described in previous sections. The method was still promising and we have been developed it in our further studies (Häkkinen, Järvelä & Mäkitalo, 2003).

Discussion

In general, the results of our two studies point out higher levels of web-based discussion and higher stages of perspective sharing in the second study compared to the first one (Järvelä & Häkkinen, 2002). In the second study, the participants had more mutual negotiations in their web-based communication and they discussed about issues from variety of different viewpoints. It can be assumed that the higher stage of perspective sharing there is in the discussions, the more there is also reciprocal understanding in

discussions. The levels of educational value supported also the claim of that the reciprocal understanding is an important fact for reaching the educationally high-level discussion. The discussions with mutual negotiations and cross-references were at the higher level as far as educational quality was concerned.

The reasons for such high amount of perspective sharing in web-based discussions could be in the pedagogical context of this particular course, and therefore, we assume that the contribution of the pedagogical model can be noticed. Particular focus was on pedagogical model emphasizing problem-oriented case-work as well as reflection of individual and group processes during the course. Furthermore, creation of shared beliefs and values are hard to reproduce in web environment without intensive face-to-face meetings (Roschelle & Pea, 1999). During this course, the students alternately had face-to-face meetings and computer-based work. It could be that the face-to-face meetings supported participants' contributions so that the discussions become more reciprocal. The students were able to express their opinions, beliefs, and assumptions during the face-to-face meetings. As Baker, Hansen, Joiner and Traum (1999) have emphasised, common ground or mutual understanding has been claimed to be necessary for collaboration. For example, in the present study the students mutually know that they are able to use web-based conferencing tools, e-mails etc., and they have the same educational aims and experiences from field teacher training. To reinforce this shared awareness base we also created certain pedagogical solutions, which were aimed at increasing mutuality between the students. We provided students with joint theory-based readings, and set up

videoconferences for students' synchronous interaction. Students also created their personal profiles for a web-based conferencing environment to introduce themselves.

Networked technology used in different learning environments provides a learner a relevant platform for communicating and sharing knowledge. Instead, more advanced technological solutions to support many problematic issues in virtual interaction, such as lack of sense of co-presence or difficulties reaching shared understanding in the distributed teams are still missing (Fischer & Mandl, 2001; Dourish, 1999; Häkkinen, Järvelä & Dillenbourg, 2000).

Still it seems evident that some discussions lead to more effective learning than others. The illusion of virtual community is fading, and the recent research has been critical towards the possibilities of 'pure' virtual communities (Dillenbourg, 2000; Lazar & Preece, 2003). It is typical that virtual environments provide a robust combination of distance and face-to-face education as well as on- and offline relationships (Pöysä, Mäkitalo & Häkkinen, 2003). It is also clear that people acquire knowledge and patterns of reasoning from one another but also individually rooted processes play a central role in the construction of meanings in networked discussion.

Mere description of activities and discourse processes do not help us understanding why some networked discussions are educationally more valuable. There is a need to find variables that mediate discussions, and new ways to separate discussions in categories that are related to quality. Methodological innovations are also needed for more profound analysis of the kind of strategies and specific mechanisms people employ in an effort to establish common ground and reciprocal understanding in virtual interaction. In addition to

collective levels of analysis we should also consider the knowledge acquisition of individual students in CSCL environments into account. Methods should be developed not only for capturing processes and outcomes of learning, but also experienced effects and individual interpretations of participation in CSCL settings. These are some of the questions that we have tackled and continue developing in the series of our studies.

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References

Baker, M. (2002). Forms of cooperation in dyalic problem-solving. In P. Salembier & H. Benchekroun (Eds.), *Cooperation and Complexity*. Paris: Hermes.

Baker, M., Hansen, T., Joiner, R. & Traum, D. (1999). The role of grounding in collaborative learning tasks. In: P. Dillenbourg (Ed.), *Collaborative learning: cognitive and computational approaches* (pp. 31-63). Pergamon: Oxford.

Brennan, S. E. (1998). The grounding problem in conversations with and through computers. In S. R. Fussell & R. J. Kreuz (Eds.), *Social and cognitive approaches to interpersonal communication* (pp. 201-225). Mahwal, NJ: Erlbaum.

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences, 2*, 141-178.

Clark, H. H. & Schaefer, F. S. (1989). Contributing to Discourse. *Cognitive Science 13*, 259-294.

Chi, M.T.H. (1997). Quantifying qualitative analyses of verbal data: A practical Guide. *The Journal of the Learning Sciences, 6*(3), 271-315.

Cobb, P. & Bowers, J. (1999). Cognitive and Situated Learning Perspectives in Theory and Practice. *Educational Researcher, 18*(2), 4-15.

Crook, C. (1994). *Computers and the collaborative experience of learning*. Routledge: London & New York.

Dillenbourg, P. (1999). Introduction: What do you mean by collaborative learning? In: P. Dillenbourg (Ed.), *Collaborative learning: cognitive and computational approaches* (pp.1-19). Pergamon: Oxford.

Dillenbourg, P. (2000). *Virtual learning environments*. March 10, 2001, from http://tecfa.unige.ch/tecfa/publicat/dil-papers-2/Dil.7.5.18.pdf.

Dillenbourg, P., Baker, M., Blaye, A. & O'Malley, C. (1995). The evolution of research on collaborative learning. In: E. Spada & P. reiman (Eds.), *Learning in humans and machine: Towards an interdisciplinary learning science* (pp.189-211). Oxford: Elsevier.

Doise, W. & Mugny, G. (1984). *The Social Development of the Intellect.* Oxford: Pergamon.

Fischer, F. & Mandl, H. (2001). Facilitating the construction of shared knowledge with graphical representation tools in face-to-face and computer-mediated scenarios. In P. Dillenbourg, A. Eurelings & K. Hakkarainen (Eds.), *European Perspectives on Computer-Supported Collaborative Learning* (pp. 230-236). Maastricht, McLuhan Institute, 230-236.

Greeno, J. G. (1998). The situativity of knowing, learning and research. *American Psychologist, 53*(1), 5-26.

Hakkarainen, K., Järvelä, S., Lipponen, L. & Lehtinen, E. (1998). Culture of collaboration in computer-supported learning: Finnish perspectives. *Journal of Interactive Learning Research, 9*, 271-288.

Hewitt, J. & Tevlops, C. (1999). An analysis of growth patterns in computer conferencing threads. In C. Hoadley & J. Roschelle (Eds.), *Proceedings of the CSCL '99: The Third International Conference on Computer Support for Collaborative Learning* (pp. 232-241). Mahwah, NJ: Erlbaum. Available: http://kn.cilt.org/cscl99/A46/A46.HTM.

Häkkinen, P. (2001). Collaborative learning in technology-supported environments – two cases of project-enhanced science learning. *International Journal of Continuing Engineering Education and Life-Long Learning, 11*(4/5/6), 375-390.

Häkkinen, P. & Järvelä, S. (2001). *Sharing and constructing perspectives in web-based conferencing*. Paper presented at the 9th European Conference for Research on Learning and Instruction, Fribourg 28.8.-1.9.2001.

Häkkinen, P., Järvelä, S. & Dillenbourg, P. (2000). Group Reflection Tools for Virtual Expert Community - REFLEX Project. In B. Fishman & S. O'Connor-Divelbiss (Eds.), *Proceedings of the Fourth International Conference of the Learning Sciences* (pp. 203-204). Mahwah, NJ: Erlbaum.

Häkkinen, P., Järvelä, S. & Mäkitalo, K. (2003). *Sharing perspectives in virtual interaction: review of methods of analysis*. To be published in the Proceedings of CSCL 2003 conference. Kluwer Academic Publishers.

Järvelä, S. & Häkkinen, P. (2002). Web-based cases in teaching and learning – the quality of discussions and a stage of perspective taking in asynchronous communication. *Interactive Learning Environments, 10*(1), 1-22.

Järvelä, S. & Häkkinen, P. (2003). The levels of web-based discussions – using perspective-taking theory as an analysis tool. In H. van Oostendorp (Ed.), *Cognition in a digital world* (pp. 77-95). Lawrence Erlbaum Associates.

Koschmann, T. (1996). CSCL: *Theory and practice of an emerging paradigm*. Mahwah, NJ: LEA.

Lazar, J. & Preece, J. (2003). Social Considerations in Online Communities: Usability, Sociability, and Success Factors. In H. van Oostendorp (Ed.), *Cognition in a digital world* (pp. 127-151). Lawrence Erlbaum Associates.

Leinonen, P., & Järvelä, S. (2003). Individual Students' Interpretations of Their Contribution to the Computer-Mediated Discussions. *Journal of Interactive Learning Research, 14*(1), 99-122.

Light, P., Littleton, K., Messer, D. & Joiner, R. (1994). Social and communicative processes in computer-based problem solving. *European Journal of Psychology of Education, 9*(1), 93-109.

Lipponen, L. (2001). *Computer-supported collaborative learning: From promises to reality*. Doctoral dissertation, University of Turku, Series B, Humanoira, 245.

Littleton, K. & Häkkinen, P. (1999). Learning Together: Understanding the processes of Computer-based Collaborative Learning. In: P. Dillenbourg (Ed.), *Collaborative learning: cognitive and computational approaches*. British Library Cataloguing Publication Data.

Markova, I., Graumann, C. & Foppa, K. (1995) *Mutualities in Dialogue*. New York: Cambridge Universty Press.

Pöysä, J., Mäkitalo, K. & Häkkinen, P. (2003). *A participant experience method for illustrating individuals' experiences in the course of evolving virtual learning community*. To be published in the Proceedings of CSCL 2003 conference. Kluwer Academic Publishers.

Resnick, L. B., Levine, J. M. & Teasley, S. D. (1991). (Eds.) *Perspectives on socially shared cognition*. Washington, DC: American Psychological Association.

Roschelle, J. & Pea, R. (1999). Trajectories from today's WWW to a powerful educational infrastructure. *Educational Researcher, 43*, 22-25.

Saarenkunnas, M., Järvelä, S., Häkkinen, P., Kuure, L., Taalas, P. & Kunelius, E. (2000). NINTER - Networked interaction: theory-based cases in teaching and learning. *Learning Environments Research, 3, 35-50.*

Salaberry, M. R. (1996). The theoretical foundation for the development of pedagogical tasks in computer mediated communication. *CALICO Journal, 14*(1), 5-34.

Scardamalia, M., & Bereiter, C. (1996). Computer support for knowledge-building communities. In T. Koschmann (Ed.) *CSCL: Theory and practice of an emerging paradigm* (pp. 249-268). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Schwartz, D.L. (1995). The Emergence of Abstract Representations in Dyad Problem Solving. *The Journal of the Learning Sciences, 4*(3), 321-354.

Selman, R. L. (1980). *The growth of interpersonal understanding*. New York: Academic Press.

Silverman, D. (1993). *Interpreting qualitative data. Methods for analysing Talk, Text and Interaction*. London: Sage.

Wilson, B.G. (1996). *Constructivist learning environments: Case studies in instructional design* (pp. 151-164). Englewood Cliffs, NJ: Educational Technology Publications.

Vitae

Professor Päivi Häkkinen has actively contributed to the national and international field of educational technology in the roles of researcher, instructional designer, educator and consultant. Her main research interests are related to design and evaluation of computer-based learning environments, computer-supported collaborative learning and virtual learning environments in various educational and corporate settings. In addition to her work as a professor in the Institute of Educational Research, University of Jyväskylä, during the academic year 1998-1999 she has been working as a visiting Research Fellow at the Institute of Educational Technology in The Open University (UK) with the support of EU-funded Marie Curie Research Training Grant.

Professor Sanna Järvelä is working at the University of Oulu, and leading there a research group focusing issues of learning processes in new technology-based learning environments, especially on social and motivational processes in learning. Järvelä has published in international journals and she has been active in national and international scientific organizations. She has been invited to participate in different expert tasks in ICT and learning by the Ministry of Education and OECD. During the year 2000-2001 she was acting as a visiting Research Fellow at Kings College in London.

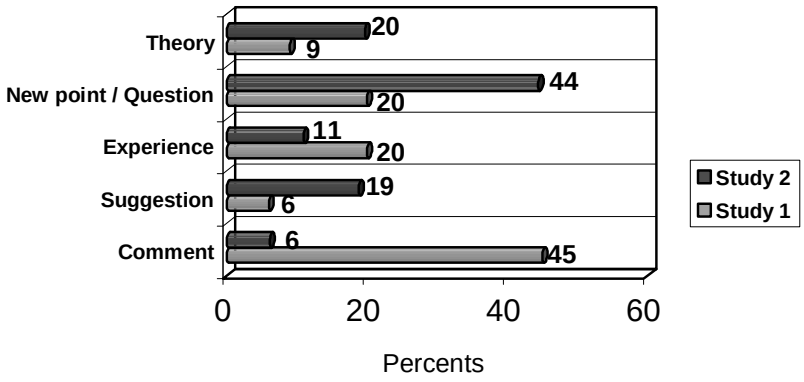

Figure 1. Types of messages in Study 1 and Study 2.

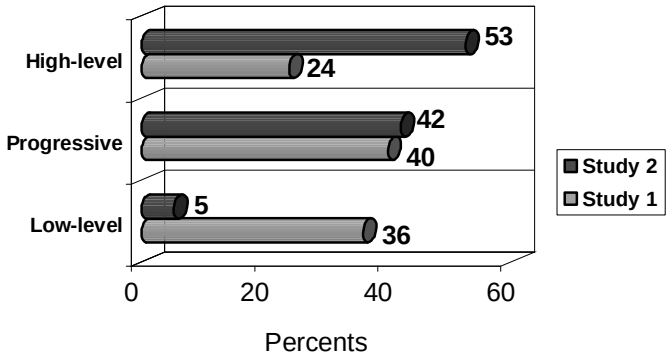

Figure 2. Level of discussion in Study 1 and Study 2.

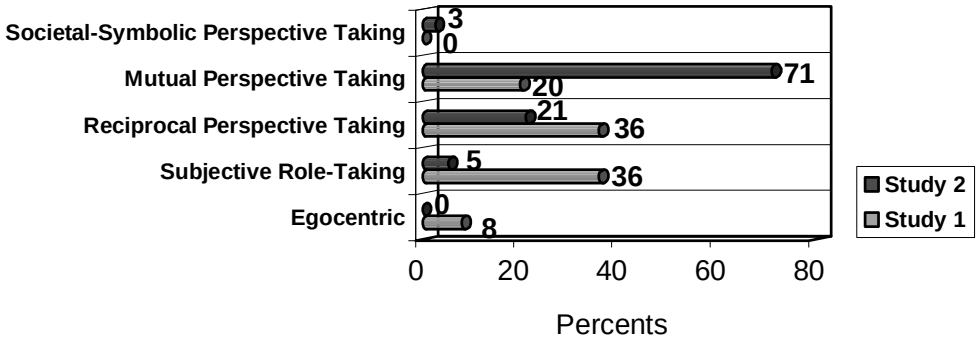

Figure 3. Stages of perspective-taking in Study 1 and Study 2.

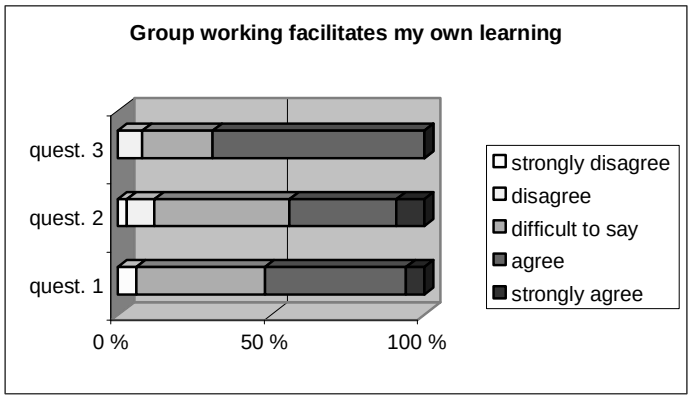

Figure 4. The experienced effects of group working on own learning

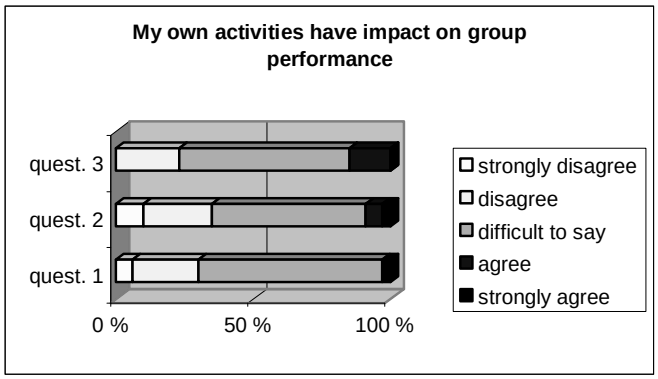

Figure 5. The experienced effects of own activities on group performance