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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 thereby 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. Particular attention is paid to the qualitatively distinct ways in which individual students interpret their participation in virtual interaction and the impact of group working on their own learning. These findings lead us on to discuss specific processes by which participants could better understand each other, create joint goals and construct meanings in virtual interaction.

Keywords: Computer-mediated communication; Co-operative/collaborative learning; Learning communities; Pedagogical issues

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1. Introduction

One of the essential requirements in rapidly changing society is to prepare learners for participation in socially organised activities. Shifting the focus away from purely 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 teamwork) clearly set demands for developing pedagogical models, tools and practices to support collaborative learning in virtual environments (De Corte, Verschaffel, Entwistle, & Van Merriëboer, 2003). 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; Saarenkunnas et al., 2000). Interactive communication on the web is very much dependent on text, and learning in asynchronous learning communities provide a very different learning environment compared to face-to-face communities (Clark & Brennan, 1991; Salaberry, 2000). Some of the most important processes in human communication, like creation of mutual understanding or shared values and goals, are hard to reproduce in virtual communities. A great deal of information conveyed by face-to-face interaction is derived from such things as tone of voice, facial expressions and appearance. Therefore, asynchronous interaction without immediate social interaction has many challenges to overcome because the communicating parties are continuously faced with the task of constructing a mutual cognitive environment or common ground.

To conclude, collaborative processes are often over-generalised, 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).

2. Issues of computer-supported collaborative learning

Research findings on computer support for collaborative learning have been contradictory, and several studies have indicated collaborative learning to be a far more complex phenomenon and difficult to realise 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, more recent research trends for collaborative learning have started to focus on particular processes and mechanisms that either support or constrain the 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 (Dillenbourg, 1999; Puntambekar & Luckin, 2003). Collabo-

rating 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, mutual regulation etc., which furthermore can trigger collaborative learning mechanisms such as knowledge articulation as well as sharing and distributing the cognitive load (Dillenbourg, 1999).

Typical features for collaborative interaction in networked environments include short discussion threads as well as descriptive and superficial knowledge instead of finding deeper explanations for the phenomena under study (Järvelä & Häkkinen, 2002). It has also proven difficult to generalise and integrate pieces of knowledge that are approached from multiple perspectives (Schwartz, 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 between the participants in networked environments (Fischer & Mandl, 2001; Järvelä & Häkkinen, 2002). New kinds of learning environments are produced for shared problem solving and enhanced interpersonal interaction by computer-mediated communications, accounting for the lack of nonverbal communication, greater individual involvement and new kinds of turn-taking skills required by networked environments (Salaberry, 1996, 2000). Asynchronous interaction without immediate social contact has many challenges to overcome since the communicating parties are continuously faced with the task of constructing their mutual cognitive environment or common ground. 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 asynchronous communication (Fischer & Mandl, 2001; Salaberry, 1996).

Theories on social interaction and learning (Doise & Mugny, 1984; Markova, Graumann, & Foppa, 1995) have given insight into the specific processes of human interaction such 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 methods in Computer-Supported Collaborative Learning (CSCL) research deals with analysing the patterns of participation and discourse (Hewitt & Tevlops, 1999; Lipponen, 2001). However, the method does not usually reveal what makes some participants of a 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 a quantitative phenomenon or organisational structure, it is also important to examine the level of individual students in CSCL settings (Leinonen & Järvelä, 2003). This level of analysis can focus either on the assessment of individual learning outcomes or on the experienced effects and interpretations of participation in the learning community. Our hypothesis is that in order to move to successful web-based learning and virtual interaction in education we need to know more about the basic processes of human interaction and learning, and

how to use that knowledge to promote the quality of virtual interaction in networked technology contexts.

3. Aims

The purpose of this study is to report the results of 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 included more perspective sharing than some others were also searched for with the aid of an on-line questionnaire focusing on individuals' experiences.

4. Research design

4.1. Subjects

The subjects of the study are pre-service teachers from different countries. In the first study, the students ($N = 70$) came from the United States (University of Indiana) and Finland (Universities of Oulu and Jyväskylä). In the second study, there were students ($N = 116$) from the United States (University of Indiana), from Great Britain (University of Warwick) and from Finland (Universities of Oulu and Jyväskylä). For all these students, their participation in the 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 the Internet. The web-based projects lasted two months in the first study and three months in the second study.

4.2. Task and tools

The learning task was to construct case-based descriptions in areas such as learning contexts or technology in education as well as about 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 the students' fieldwork observations of 'theory in action'. For example, the 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 scaffold student learning. Mentoring was organised 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 a shareware conferencing system called Conferencing on the Web (COW), and in the second study they used the Proto environment, a program developed at 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).

5. Method

5.1. Data collection

A combination of quantitative and qualitative research methods was employed. Quantitative data included: (1) computer-generated usage statistics indicating the nature, time and volume of participation (the amount of messages, replies, 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.

5.2. 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 in the second study only. First, each discussion was subjected to a preliminary analysis and the types of messages were grouped into the following categories: Theory/New point, Question/Experience/Suggestion/Comment. After that cross-references between the student messages within discussions, and mentors' messages were marked. Moreover, certain quantifications were compiled 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 to demonstrate the progress of a discussion, the dynamics of different types of messages, mentors' role and cross-referring in each discussion. The graphs were researchers' analytic tools, which helped divide all the discussions into three groups: high-level discussions, progressive discussions and low-level discussions. Two researchers made independent estimates of the levels of discussions. Their classifications matched perfectly for 80–95% of codings. The contradictory analyses were negotiated until a unanimous estimation was reached.

In the third phase, a specific analysis about the 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. This model includes developing understanding of how human points of view are related and coordinated with one another. Following the Piagetian tradition, this theoretical approach is a strongly structural-developmental construct originally developed in studies of social and moral reasoning (Selman, 1971). In spite of this, the basic model of Selman's theory gives a theoretical insight into the level of interaction in other contexts, such as negotiation and shared experience (De Vries & Zan, 1996). Virtual interaction basically involves the essential features of reciprocity; therefore Selman's (1980) theory can give a theoretical insight for developing a model on which further analyses can be based. Certain key aspects encompass, for example, the deeper meaning of the virtual interaction features and the level of participants' perspective taking. In this study the approach was taken to include both the developmental

perspective of how reciprocal understanding is moulded during a long-term virtual interaction, and secondly, how and at what stages this mutual understanding evolves to higher levels in terms of perspective taking. In our study, Selman's (1980) categories for perspective taking were adapted to develop a coding category for exploring the quality of asynchronous electronic discussion (for more details, see Järvelä & Häkkinen, 2003).

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 categories and the analysis procedure have been described in more detail by Järvelä and Häkkinen (2003).

In order to capture the qualitatively different ways in which students experienced the effects of and prerequisites for collaborative learning we analysed 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 work facilitate learning in general? (2) How does group work facilitate my own learning in particular? and (3) What kind of impact do my own activities have on group performance? (cf. Häkkinen & Järvelä, 2001). The experienced effects were evaluated by means of multiple-choice questions and content analysis (Chi, 1997) of the responses to open-ended questions.

6. Results

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 Study 1 since the results pointed out serious problems in the perspective sharing between the students.

6.1. Pedagogical model

Following the principles of intervention studies in authentic contexts (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 the web (Järvelä & Häkkinen, 2003; Saarenkunnas et al., 2000). In terms of designing pedagogical implications to enhance high-quality virtual interaction we emphasised the following approaches.

1. The students were engaged in problem-oriented case work (Scardamalia & Bereiter, 1996). They were expected to redefine the original problem as well as summarise and 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 were supported by participant observation (Silverman, 1993). The role of face-to-face meetings was essential for the grounding process throughout the course.

6.2. Types of messages

In the first study, during the two-month period, the students produced 25 different discussions with 10–30 messages in each discussion. In the second study, during the three-month 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 Study 2 than in Study 1. In Study 1, about 9% of the messages were theory-based and 20% new points or questions, whereas in Study 2 20% of the messages were theory-based and 44% new points or questions. Compared to Study 1 (45%), the percentage of comments was clearly decreased in Study 2 (6%). There were fewer suggestions in Study 1 (6%) than in Study 2 (19%). The share of experience-based messages was 20% in Study 1 and 11% in Study 2 (see Fig. 1).

6.3. 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 proportion of high-level discussions was increased and the proportion of low-level discussions decreased (see Fig. 2). The categorisation of discussions into three different groups according to their educational value indicated that 53% of discussions in Study 2 and 24% in Study 1 were high-level discussions, whereas 42% in Study 2 and 40% in Study 1 were progressive discussions, and the remaining 5% in Study 2 and 36% in 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-referencing between messages was also typical. Progressive discussions also involved some cross-referencing, generalisations and joint knowledge-construction but also

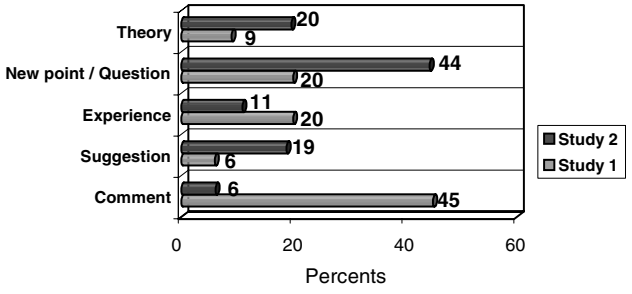

Fig. 1. Types of messages in Study 1 and Study 2.

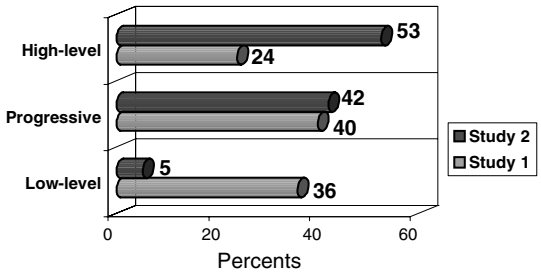

Fig. 2. Level of discussion in Study 1 and Study 2.

plenty of comments, experience-based messages and messages with new points or questions. However, no theory-based discussion occurred in this category. 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.

6.4. How were the perspectives shared?

Discussions were also analysed through categories based on the socio-cognitive perspective taking theory. The purpose was to show us how the perspectives were shared in web-based discussions. Compared to Study 1, the results of 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 perspective or otherwise more generalised angle. The discussion typically progressed from mutual sharing of experiences (personal points of view) to more elaborative argumentation, and developed toward discussions about more general points in education or society, for example. The stage 2 approach, Reciprocal Perspective Taking occurred in 21% of the discussions in Study 2 and in 36% of the discussions in 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 Study 2, one discussion (3%) also reached the highest stage of perspective sharing (Societal-Symbolic Perspective Taking), which did not occur at all in Study 1. Typical of this kind of discussion was that students abstracted multiple mutual perspectives into a societal, conventional, legal or moral perspective, one that all the individuals could share. In Study 1, 8% of the discussions were categorised to the lowest stage (Egocentric), whereas none of the discussions in Study 2 were categorised to this stage. In these discussions, students just presented subjective and egocentric expressions, and messages remained incoherent. 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 the messages of discussion with alike messages. Subjective Role-Taking was, however, fairly common (36%) in Study 1 (see Fig. 3).

6.5. 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

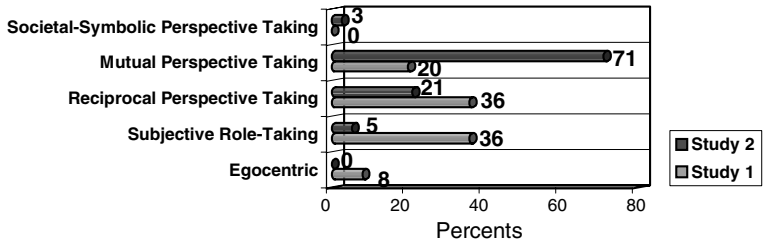

Fig. 3. Stages of perspective-taking in Study 1 and Study 2.

discussions were mostly egocentric and superficial. For example, in this second study, the discussions that were educationally at the higher level were either at stage 4, stage 3 or stage 2 in terms of perspective taking. Most of them (18 discussions) were at stage 3 (Mutual Perspective Taking). One of the high-level discussions was at stage 4 (Societal-Symbolic Perspective Taking) and one at stage 2 (Reciprocal Perspective Taking). The progressive level discussions (16) were characterised with either stage 3 or stage 2 perspective taking. Nine of the discussions were at the Mutual Perspective Taking stage (stage 3) and seven at the Reciprocal Perspective Taking stage (stage 2). The low-level discussions (2) stayed at the Subjective Role-taking stage (stage 1).

6.6. 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 regarded the impact of group working for their own learning as fairly positive, but interpreted their own contribution to the group more modestly (see Figs. 4 and 5).

The three on-line questionnaires were administered to the students in Study 2 at about two-week intervals. Even though the virtual course was relatively short, there were clear changes in students' experienced effects. In particular the personal meaningfulness of web-based collaboration increased (see Fig. 4).

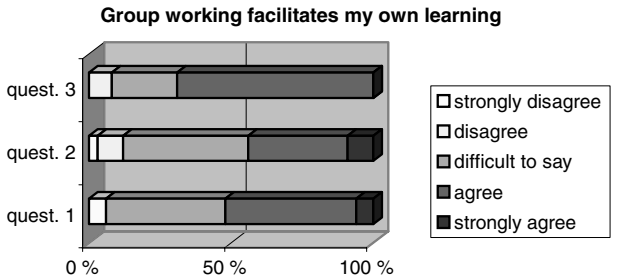

Fig. 4. The experienced effects of group working on own learning.

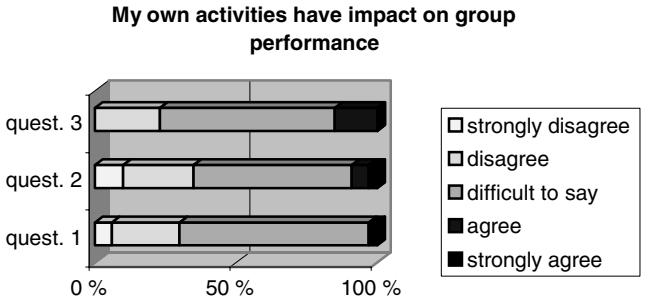

Fig. 5. The experienced effects of own activities on group performance.

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). More than a fourth 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-ended questions, and it illustrates one student's experience of cognitive achievements.

> *''Exchanging 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 unclear points in a group.'' [Finnish female student, pre-service teacher education, University of Oulu]*

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

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

The role of cognitive conflict, and particularly the socially mediated processes of conflict resolution through argumentation (Dillenbourg, 1999) were mentioned by 10% of the students.

> *''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]*

6.7. 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 personal responsibility and efforts made by students themselves.

''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 training majoring in English philology, University of Jyväskylä]

When used adequately, methods that focus on individuals' personal experiences and interpretations can make up the core of a methodological approach. However, in our studies we used one such method to support and complement the primary methods described in previous sections. The method was promising, nonetheless, and we have been developing it in our further studies (Häkkinen, Järvelä, & Mäkitalo, 2003).

7. Discussion

In general, the results of our two studies show 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 issues from a variety of different viewpoints. It can be assumed, therefore, that the higher the stage of perspective sharing, the more reciprocal the participants' understanding is. Findings concerning the levels of educational value also supported the presumption that reciprocal understanding is an important factor for reaching 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 a high degree of perspective sharing in web-based discussions can be attributed to the pedagogical context of this particular course, and we assume, therefore, that the contribution of the pedagogical model developed for the second study can be noticed. A particular focus was on a pedagogical model emphasising problem-oriented case work as well as reflection on individual and group processes during the course. However, the construction of shared beliefs and values is hard to reproduce in a 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 the participants' contributions so that the discussions became 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, some degree of common ground or mutual understanding has been considered 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 similar educational aims and experiences from field teacher training. To reinforce this shared awareness we also created certain pedagogical solutions, which were aimed at increasing mutuality between the students. We provided students

with shared theory-based reading materials, and set up videoconferences for students' synchronous interaction. Students also created personal profiles for a web-based conferencing environment to introduce themselves.

The network technology used in different learning environments offers the learner a relevant platform for communicating and sharing knowledge. On the other hand, there is a lack of more advanced technological solutions to support virtual interaction, for instance, as regards the limited sense of co-presence or difficulties in reaching shared understanding within distributed teams (Fischer & Mandl, 2001; Häkkinen et al., 2000). These challenges become emphasized particularly in asynchronous learning environments without immediate social contact, where new kinds of turn-taking skills are required.

It seems evident that some discussions lead to more effective learning than others. The illusion of virtual community is fading, and recent research has been rather critical towards the possibilities of 'pure' virtual communities (Dillenbourg, 2000; Lazar & Preece, 2003). It is typical that virtual learning 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.

There are also limitations in this study, mainly because of the research design. Since the two studies involved authentic preservice teacher education courses, we were not able to control the composition of the subjects of study. However, this "natural heterogeneity" reflects fairly well the typical situation in international virtual courses and, thus, mirrors the authentic context. Furthermore, the main focus in analysing perspective sharing was on the level of whole virtual discussion, not on the level of individual messages. Another limitation can be attributed to the two-year interval between the first and second study. This was the time we needed for the development of the pedagogical model, and we were not able to schedule the studies in any other way. However, we believe that the these methodological limitations are not too serious bearing in mind the main focus of the study; namely studying the perspective sharing in web-based discussions and particularly identifying the connection between the level of discussion and perspective sharing. Despite the limitations in the research design, the general characteristics related to perspective sharing can be recognized and reflected in the settings of the two studies.

Mere description of activities and discourse processes, as such, will not help us understand why some networked discussions are educationally more valuable. There is a need to identify the intervening variables that affect various types of discussions and to find new ways to classify discussions into relevant categories 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. Methods should be developed not only to capture the processes and outcomes of learning, but also the experienced effects and individual interpretations of participation in CSCL settings. These are some of the questions that we have tackled and will keep on 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). Oxford: Pergamon.

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., & Brennan, S. (1991). Grounding in communication. In L. Resnick, J. Levine, & S. Teasley (Eds.), *Perspectives on socially shared cognition*. Washington, DC: Americal Psychological Association.

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*. London and New York: Routledge.

De Corte, E., Verschaffel, L., Entwistle & Van Merriëboer, J. (Eds.). (2003). *Unravelling basic components and dimensions of powerful learning environments*. Amsterdam: Elsevier.

De Vries, M., & Zan, X. (1996). Assessing interpersonal understanding in the classroom context. *Childhood Education, 72*(5), 265–268.

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

Dillenbourg, P. (2000). Virtual learning environments. March 10, 2001, Available 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.

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.

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. In B. Wasson, S. Ludvigsen, & U. Hoppe (Eds.), Designing for change in networked learning

environments. *Proceedings of the international conference on computer-support for collaborative learning 2003* (pp. 395–404). Dortrecht: Kluwer Academic Publishers.

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 from http://kn.cilt.org/cscl99/A46/A46.HTM.

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). London: 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). London: 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, p. 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 University Press.

Puntambekar, S., & Luckin, R. (2003). Documenting collaborative learning: what should be measured and how?. *Computers and Education, 41*, 309–311.

Pöysä, J., Mäkitalo, K., & Häkkinen, P. (2003). A participant experience method for illustrating individuals' experiences in the course of evolving virtual learning community. In B. Wasson, S. Ludvigsen, & U. Hoppe (Eds.), Designing for change in networked learning environments. *Proceedings of the international conference on computer-support for collaborative learning 2003* (pp. 451–460). Dortrecht: Kluwer Academic Publishers.

Resnick, L. B., Levine, J. M., & Teasley, S. D. (Eds.). (1991). *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.

Salaberry, M. R. (2000). Pedagogical design of computer mediated communication tasks: Learning objectives and technological capabilities. *Modern Language Journal, 84*(1), 28–37.

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, NJ: 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. (1971). The relation of role taking to the development of moral judgement in children. *Child Development, 42*, 79–91.

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.

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