
Drafts of Culture of collaboration in computer-supported learning: A Finnish perspective

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Abstract

The purpose of the present study was to analyse how the social interactional approach of computer-supported collaborative learning meshes with the Finnish school environment. Our aim is to discuss what aspects of Finnish educational culture, and particularly communication culture, support or hinder the restructuring of educational practices according to cognitive principles of learning and technology-based learning environments. We claim that social interaction which supports students' learning cannot be explained by mainstream theories on collaboration, but cultural, contextual, and individual differences make collaboration more complicated. We report on three experimental studies where the communication culture of computer-supported collaborative learning was analysed. These analyses revealed that Finnish students do not typically get involved with intensive interaction about partially formed ideas. Differing opinions and interpretations expressed in discussion often cause cognitive conflicts that an agent tries to solve internally before going back to the social plane. This culturally typical pattern of interaction seems to be more closely related with the Piagetian (socio-cognitive conflict) theoretical framework and differs from that of the Vygotsky and the neo-Vygotskians (intersubjective construction). Furthermore, the studies reported here suggest that patterns of interaction described above may be closely related to maladaptive socioemotional coping strategies and a fact-oriented educational epistemology. Nevertheless, technology-based learning environments and participation in corresponding research-like learning tasks seem to foster productive interaction between students.

Introduction

Being influenced by modern research on learning, today's classroom culture in Europe and North America has begun to change from the traditional teacher-centred approach towards more collaborative approaches. With facilitating technologies, researchers are now investigating the practices and artefacts by which students co-ordinate and share their work (Koschman, 1994; O'Malley, 1995). This is seen, for example, in the rich terminology describing collaborative learning in recent literature on learning and instruction (e.g., Elbers, 1996; Koschman, 1994; Littleton & Häkkinen, 1997). Furthermore, there have been many experimental comparisons of students working in pairs and groups. A substantial body of empirical evidence demonstrates the value of collaborative learning as compared with individual learning (e.g., Tudge & Rogoff, 1980; Slavin, 1989). Still, criticism of 'universally successful' collaborative learning has followed from rather contradictory results of studies of how various students respond to different instructional environments (e.g., Dillenbourg, Baker, Blaye & O'Malley, 1995; Lehtinen, Vauras, Salonen, Olkinuora, & Kinnunen, 1995; Salomon & Globerson, 1989).
Distinct explanations about the quality of collaborative learning have been provided by different theoretical traditions and related empirical research (Dillenbourgh et al., 1995; Blumenfeld, Marx, Soloway, & Krajcik, 1996; Tudge, Winterhoff, & Hogan, 1996). The sociocognitive approach, for example, takes account of conflict and the co-ordinating points of views between the students (Glachan & Licht, 1981; Perret-Clermont, Perret, & Bell, 1991). A sociocultural perspective on collaborative learning focuses on the quality of the observed talk and the mediation of meaning in the process of teaching and learning (Mercer, 1996). The situated cognition approaches view collaboration as the process of building and maintaining a shared conception of a problem (Hutchins, 1995; Roschelle & Teasley, 1993). Even though the diversity of theoretical frameworks and methodologies in different empirical studies has provided strength to the broad tradition of collaborative learning, the focus of the many studies remains restricted, since different frameworks may only serve to highlight alternative facets of students' collaborative endeavours.

Recently, Cobb and his colleges explored the possibilities of co-ordinating the constructivist analyses of individual activity and interactionist analyses of classroom interaction (Cobb & Yackel 1997). Although this emerging perspective may offer more individual and context-sensitive theoretical approaches for future studies on collaborative learning, arguably its effectiveness cannot be explained as only the result of differences in specific abilities, cognitive practices, or contextual conditions. Research on social interactions in learning has focused primarily on verbal components of the interaction while providing limited attention to how non-verbal communication and gestures may influence to the quality of social interaction (cf. Kelly & Church, 1997). Important here is Rogoff's (1993) notion of guided participation in which learners are viewed as active in their own learning not only through explicit communication to those around them, but also through tacit communication. It seems plausible that collaboration is influenced by dynamic interactions between cognitive, affective, and motivational variables (Pintrich, Marx, & Boyle, 1993).

In this paper, our aim is to discuss what aspects of Finnish educational culture, and particularly the quality of communication culture, support or hinder the restructuring of educational practices according to cognitive principles of learning and technology-based collaborative learning environments. Our method, however, was not constructed to directly yield comparative data for Finnish in relation to other cultures. In the present exploratory study, the data are intended to provide for deeper understanding of collaborative learning in the Finnish situation; it is expected that further rigorous investigation will yield explicit comparative data shedding light on the precise degree and kind of characteristics of learning in the Finland as compared to other contexts.

We argue that social interaction which supports students' learning cannot solely be explained by mainstream theories on collaboration, but instead cultural, contextual, and individual differences make a genuine account of collaboration more complex. We examine the culture of collaboration in the context of technology-supported learning environments by focusing on three different dimensions of students' learning and interacting processes. First, the patterns of interaction are discussed by comparing Piaget’s and...
Vygotsky’s approaches to social interaction. Second, student social interaction and the development of socioemotional coping strategies are analysed. Third, the patterns of interaction affecting knowledge processing are investigated.

Piagetian and Vygotskian Approaches to Learning and Collaboration

An important assumption of Piaget's (1980, 1985) theory was that the source of conceptual development is alternation between equilibration and disequilibration of cognitive structures. Piaget argued that the cognitive value of social interaction is based on a process in which emerging socio-cognitive conflicts create a state of disequilibrium within an agent, thereby pushing him or her to go beyond current states of knowledge and construct new conceptual structures. A central assumption of the model is that interaction between agents having different levels of conceptual understanding is, in a cognitive sense, conflictual in nature (e.g., Ames & Murray, 1982; Doise & Mugny, 1984). As a consequence, new knowledge is not directly constructed on the social plane, but rather by solving internalised cognitive conflicts. It follows that the Piagetian pattern of social interaction is a discontinuous rather than a continuous process. In effect, as cognitive conflicts interrupt the process of interaction repeatedly, the process continues in the mental plane until the conflict is resolved, and only after that does the agent come back to the social plane (see Figure 1).

In contrast, according to Vygotsky's (1962, 1978) socio-cultural theory, interaction between less and more able members of a community fosters conceptual growth through internalisation of cultural-historically formed conceptual tools. Interaction between peers representing different levels of conceptual understanding or cognitive and metacognitive practices enables each participant to achieve new competencies or skills within his or her zone of proximal development. In this view, students are able to come to new understanding through interaction in which they jointly develop, initially, only partially articulated conceptions (e.g., Rogoff, 1990).

Social interaction based on this neo-Vygotskian model is a rich interactive process in which the participants present in verbal form their partially articulated ideas, internalise new knowledge, and develop shared understanding about the issues in question. From the Vygotskian model, it follows that interaction continues while the agents construct knowledge in parallel on the social and mental planes (see Figure 2). We do not consider these two models of interaction to be mutually exclusive, but rather assume that their
relative importance may vary from one culture (or even from one learning situation) to another.

Insert Figure 2 here

Culturally Typical Patterns of Interaction

Lehtinen and Repo (1996) analysed the development of understanding of the concept of the derivative (within calculus) in the context of computer-supported learning. High school students (N=17), in studying derivatives, explored different mathematical functions with the help of the DERIVE program. All 50 hours of lessons required by the experimental program were videotaped. A selection of interaction episodes between pairs of students was analysed qualitatively focusing on an interaction between 10 pairs of students in general, and emerging cognitive conflicts and shared understanding between the students in particular.

Examination of the videotapes revealed several specific types of communication pattern. First, these analyses indicated that typical Finnish high school students communicate with the help of the computer as a mediating artefact instead of verbally. Discontinuous communication episodes were frequently observed in data analysis. Student pairs or one student and the teacher started to discuss a mathematical problem or concept introduced by the teacher. This verbal interaction was, however, interrupted long before the necessary steps of the problem solving or concept formation had been dealt with in the common discussion. Later it was possible to observe that students had constructed, individually, an adequate understanding of the problems which enabled them to contribute to the discussion with a ready solution.

A second communication type was also common for the students. While working with a computer in pairs, students continuously referred to the procedures presented on the computer screen. During long interaction episodes they frequently used objects presented on the computer screen to intensively communicate with each other without any verbal communication. Typical of these interaction episodes was that there were almost no verbal utterances, or the utterances were only intended to call the partner's attention to some manipulation carried out by the student or some result presented on the screen. Turn-taking behaviour was also typical in this communication. First one student performed some manipulation with the computer and then both students looked at the results. After a period of non-verbal communication (e.g., gestures and an eye contact), the other took the keyboard and carried out the next manipulation.

The patterns of interaction described above do not appear to be in straightforward accordance with the neo-Vygotskian notion of socially shared construction of knowledge
through social interaction. There were neither lively public interactions nor continuous processes of refinement of partially articulated ideas. The patterns of interaction described, represent rather a complex process in which the focus of knowledge processing moved continuously from the social to the mental plane, frequently causing periods of silence. The computer environment mediated communication between the pairs of students and provided valuable support for advancement of the subjects' mutual understanding (Moschkovich, 1996; Teasley & Roschelle, 1993). On the other hand, the computer and the specific program used in the experiment can be interpreted as culturally constructed artefacts which have a function somewhat similar to a communicative tool rather than to natural language.

Patterns of Interaction and Socioemotional Coping Strategies

Piaget's (1980; 1985) concept of cognitive conflict does not entail that social interactions leading to disequilibria would be experienced as conflictual or emotionally threatening. This, however, appears to be a special characteristic of the Finnish instantiation of the Piagetian pattern of interaction. Presumably Finnish school children's motivational and emotional coping strategies are important intermediate variables that partially explain culturally typical patterns of interaction at school. Patterns of interaction typical of the predominant school culture and classroom learning seem to support and develop certain kinds of non-optimal motivational orientations, such as ego-defensive and social-dependency orientations for dealing with achievement requirements of school (Lehtinen et al., 1995; Salonen, Lehtinen & Olkinuora, 1997). In contrast, a technology-based learning environment seems to foster productive task-related interactions and enhance effective motivation (Järvelä, 1998).

Järvelä (1995, 1998) examined how pairs of upper elementary school students representing different motivational orientation interacted while working within a technology supported learning environment. The goal of the study was to analyse students' social and motivational interpretations of cognitive apprenticeship-based (Collins, Brown, & Newman, 1989) learning, interaction and to consider the possible dynamics of these interpretations in relation to students' motivational orientation and learning processes. The study was carried out as follows: Secondary school students were asked to construct physical models of automated machines during a 15-hour learning project by using Lego-bricks and writing Logo programs in order to control the functioning of the models. The subjects were 14 male students from the 7th grade of a Finnish upper comprehensive school. Before the experimental lessons, the students' motivational orientation tendencies in a traditional classroom were rated with the help of paper and pencil tests and teacher ratings. On that basis, 6 students--two task-oriented, two ego-defensively disposed, and two social dependency disposed--were designated for a detailed qualitative analysis. Qualitative on-line data for the working processes and teaching-learning interactions were collected during the experiment. The work of student pairs was videotaped, and after each
session, the students were interviewed using a stimulated recall method. In the microlevel process analysis, the student's motivational orientation and situational strategies were classified according to a pre-specified system of categories.

The results indicate a tendency toward task orientation and working processes among the students in an apprenticeship situation. Students with strong tendency to non-task-orientation in traditional classroom situations tended to act in an increasingly task-oriented way during the experiment (see Example 1). The open technology-based learning environment appears to have facilitated the quality of social interaction, which was seen in some reciprocal interaction episodes between the teacher and the students where higher-order thinking was apparent.

Example 1. Task-oriented self-regulated activity

OLAVI: Hi! [The teacher comes up to the boys.] We have this great program here but it won't work.

HANNU: It won't accept "bird" and "cap" ["bird" and "cap" are commands in the boys' program].

TEACHER: I see ... you've invented, you do have, good names for the commands. But where's the problem, then?

OLAVI: That "bird." It's the "bird" command.

HANNU: It won't do anything when you type in "bird."

OLAVI: There's a program, a language ... [explains the structure of the program].

TEACHER: There are two "bird" commands.

OLAVI: ... and you can't put that. So I'll erase this one and add the other one, which will reset all that.

TEACHER: That's right, put that one there.

HANNU: 'Healthyhands'!

OLAVI: What? Written together? [types it on the screen] And then "to" healthyhands. [The boys are starting to look enthusiastic.]

TEACHER: That's great!

TEACHER: The idea here is that if you define two things with the same name, it'll accept only the last one.

OLAVI: All right, now go down, down, down.
Let's take that "cap" now. [Types "cap" on the screen, but the program does not work.]

TEACHER: It doesn't recognise it.

OLAVI: But shouldn't the "cap" program be here?

TEACHER: Go forward a bit ... I think I know what the problem is, here. You should have something there, you see. And that is ...?

HANNU: "End"? [Teacher snaps his fingers to show that Hannu's answer was correct. [The students look satisfied and continue to work.]

In contrast to task-orientation, the ego-defensive student's relation to the conventional classroom interaction system is reactive. Because a student is sensitised to a situation, specific features of classroom interaction, for example, searching for the teacher's emotional cues, he or she is apparently may not be able to concentrate on task-related activities (Diener & Dweck, 1978). The students who increased task orientation demonstrated a point that a marked change in the learning and social interaction system may be a relief for an ego-defensive student and help him or her to activate task-related interest of other-related coping behaviour (See Example 2). The open-ended projects allow task approaches may help the ego-defensive student to handle fear of failure and facilitate goal-oriented cognitive activity, for example, reflection.

Example 2. Increased task-orientation in ego-defensive students’ interaction

[Jari has some problems with the model and he concentrates on testing it. Jari's partner, Pasi, is building a car of Lego-bricks. He follows Jari's and the teacher's interaction, but does not take part on it. Jari's orientation tendency during traditional classroom learning can be characterised as ego-defensive orientation. During the experimental lessons, he showed a tendency toward task-orientation. It seems that the Legologo learning environment may have enchanted Jari's self-efficacy beliefs and provided an indirect impact on cognitive engagement. Jari showed metacognitive abilities, such as self-regulation and reflection.]

JARI: This doesn't change direction [thinking aloud] ... hey, teacher! [Jari continues testing.]  

TEACHER: What was your problem?

JARI: Is this correct, what do you think?
TEACHER: It depends on what do you want it to do [the model]? Look at that, there is a red pole and... [explains some details].

JARI: That's right! But I would like to know how could I get this function!? It seems that this spins only in a one direction.

TEACHER: Yes. What kind of logo commands should you give to the gate? Let's think about that...

JARI: It should go so that this... [points to the model and the teacher and Jari are observing how the model functions] All right! When it goes like this, the light should be on and the gate would stay open for a second...or it should stay on for three seconds and then it should go down.

TEACHER: Exactly! That's a good idea! Now the program, how should it go?

JARI: I'm just thinking, how could I get the gate open when the light cell goes out?

TEACHER: I think that the computer should know whether the light cell has gone out and then it should wait. I'll give you a hint: this is called a sensor and there are some commands for it... [explains and the teacher and Jari experiment].

A marked change in social interaction during learning processes may cause an emotionally threatening situation for the socially dependent student and activate ego-defensive coping behaviour (Dweck & Leggett, 1988). This is because familiar features of the social environment to which the student has adapted learning tactics have been removed. The data show how an increased demand for independent work aroused ego-defensive coping attempts among some students and led to withdrawal or off-task-work. Example 3 reveals Mika's uncertainty in the face of the new task.

Results of the study indicate that computer-supported learning environments based on open tasks and the model of cognitive apprenticeship may create a new kind of interaction culture and facilitate emergence of new adaptive strategies. In the process of constructing the legomodels, interaction mediated by the computer environment, structured students’ activities as well as fostered the achievement of reciprocal understanding.

Patterns of Interaction and Knowledge Processing

Patterns of social interaction and knowledge processing in Finnish elementary-level education were analysed in the context of an ongoing four-year longitudinal study. The purpose of the longitudinal study is to analyse how cognitive practices of school can be restructured with the help of computer-supported collaborative learning (see Lipponen &
Hakkarainen, 1997 for a detailed description of the study). The technological infrastructure of the study was provided by the Computer-supported Intentional Learning Environments (CSILE) developed by Scardamalia and Bereiter (1991).

The study involved setting up a CSILE network in a grade 3 classroom (i.e., 9-year-old students) at Finnish Elementary School. At the time the analysis was conducted, the students had been using CSILE for six months. The students were allowed to use CSILE without any intervention by the researchers in order for the latter to gain information about students' basic level of knowledge processing. The study was carried out as follows: we qualitatively analysed knowledge produced by students to CSILE's database (Hakkarainen, 1995, Lipponen & Hakkarainen, 1997; Hakkarainen & Lipponen, 1998). The data consisted of 507 written comments, 416 research questions, and 217 notes representing knowledge produced by 30 students. Structured interviews were used to obtain detailed information about the students' conceptions of their own inquiry.

Computer-supported learning within the CSILE environment seemed to be particularly motivating for Finnish male students who traditionally have had numerous difficulties adapting to externally regulated traditional school learning. On average, male students produced 60 CSILE notes (S.D. = 68) and female students 15 notes (S.D. = 10). The difference is partially explained by the fact that the CSILE teacher allowed the students to start working with CSILE after they had finished their other compulsory school assignments. As a consequence, 4 male students (two below average and two above average students) attempted to finish their other assignments at the beginning of the week in order to get the rest of the week free to work with CSILE. Each of these male students produced over 100 notes within the database.

Analysis of written communication mediated by the CSILE network revealed that the object of students' comments was factual information in 82.6% (f=419) of all comments. It was noticeable that the students did not participate in intensive interaction for jointly developing their conceptions as reported by several CSILE studies of other groups (Scardamalia & Bereiter, 1994; Hakkarainen, 1995; Hakkarainen, 1998). If we compare our results with the Canadian data there was, among Finnish students, much less corresponding discussion about the merits of the students' own intuitive theories or metadiscourse concerning practices of inquiry than in the Canadian data. However, in comparing Finnish and Canadian CSILE data, it should be taken into consideration that the Finnish CSILE students were one year younger and had started school one year latter (age 7) than the Canadian CSILE students.

The most typical pattern of communication between the students was a question-answer exchange in which a factual question was presented and a factual answer provided (see Example 4). Moreover, a disagreement led to a quick interruption of interaction mediated by the network. As a consequence, the average depth of inquiry was no more than a few steps. In some cases disagreement was also connected with personal remarks or other forms of less constructive interaction. In addition, the quality of communication as measured by explication of a comment's referential relations was not very high at this point.
in time; the references of 44.8\% (f=227) of the comments were unspecified or only partially specified.

Example 3.

Cases of question-answer exchange between Finnish CSILE students ("NI" stands for new information, "C" for a comment, "Q" for a question and "A" for an answer):

CASE 1.
Q: What is the worst accident of the space history?
A: The Apollo 13 accident.
C: Not really.

CASE 2
Q: Do space aliens exist? eh?
A: Nobody knows if space aliens exist.

CASE 3.
Q: What or who was Voyager?
A: Voyager is a probe.

CASE 4.
Q: What happens if the Earth falls into a black hole?
A: All life will be destroyed because even light cannot get away from a black hole.

Examination of knowledge produced by the Finnish CSILE students further revealed that 93.3\% of research questions (f=386) generated by the students were fact-seeking in nature (i.e., 'what', 'where', 'when' and 'how many' questions). We found 32 of the questions could not be classified. This provided a strong contrast to the Canadian CSILE students who were systematically producing explanation-seeking why- and how-questions (Hakkarainen, 1995; Hakkarainen & Lipponen, 1998). In evaluating the difference between Finnish and Canadian CSILE students, as we have mentioned, it should be taken into consideration that the Canadian CSILE students were a year older than Finnish CSILE students. However, the age variable alone cannot explain the difference. Further, 48\% of the notes in which the students' were presenting their knowledge (f=217) were assessed by the researchers as directly copied from books or some other sources of information.

To summarise, the results indicate that a rather narrow fact-oriented knowledge
processing is characteristics to educational discourse at an early level of Finnish elementary school. It seems plausible to assume that there is a close relation between fact-oriented knowledge processing and the nature of interaction. Interaction entirely focused on factual information does not seem to encourage students to personally engage in the process of inquiry and make their own commitments to one or another view. The problem with fact-oriented discourse appears to be that without considering relations between facts and theories it is very difficult to go beyond discussion concerning whether students have got their facts correct.

Conclusions

In the study we analysed Finnish school children's social interaction and practices of knowledge processing in the context of computer-supported collaborative learning. The method was not designed to yield comparative data; only Finnish young persons were involved in this exploratory effort to arrive at a deeper understanding, at the micro level, of the student/student and student/teacher interactions within the classroom. The results suggested that characteristic social interaction in Finnish schools does not involve shared articulation of partially developed ideas. In demanding interaction situations, students tend to avoid cognitive commitments and interpret disagreement in a conflictual way. They do not engage again in social interaction before solving emerged cognitive conflicts. In the present authors’ impression, this is typical of Finnish communication culture in the schools. However, in assessing results of the studies, one should take into consideration that the studies were exploratory in nature and represent only a limited variation of communicative situations in the Finnish schools. Further, as stated, our method was not intended to yield directly comparative data for differing cultures of communication in two or more countries. As a consequence of these methodological limitations, the results, understood non-comparatively, should be taken as provisional and to be confirmed by further more controlled and systematic investigations. Nevertheless, within each study there emerged the same pattern of specific practices of communication. The degree of overlap between characteristics of communication in Finnish classrooms, as compared with those of other countries, requires further investigation.

It was argued that the above described, culturally typical forms of communication are closely connected with certain sociocognitive and emotional orientations. In order to analyse this hypothesis, process-sensitive methods will be applied to analyse how different motivational and emotional coping strategies interact in CSILE use (Järvelä, Hakkarainen, Lipponen, Niemivirta, & Lehtinen, 1997). Further, special consideration will be given to examining relations between socioemotional and cognitive aspects of inquiry.

Also, it seems plausible to assume that there is a close relation between patterns of interaction in school and educational epistemology. Traditionally, students' competent membership in the classroom culture has been organised along the dimensions of social interactions and academic content (Sivan, 1986). Although the present studies are far from representative, it appears that Finnish educational culture is, thus far, too strongly focused on transmission of factual information to sufficiently foster development of advanced
collaborative skills. This may also be reflected in Finnish textbooks and teacher training (Mikkilä, Olkinuora, & Laaksonen, 1997). Even if the reported empirical phenomena would not merely represent specific characteristics of Finnish educational interaction but might have some generality, it appears, from the data gather thus far, that characteristics of Finnish communication culture make implementation of practices of collaborative learning more difficult to carry out.

However, there are numerous variables other than culturally typical forms of communication that might explain the empirical phenomena revealed by the studies (cf. Salomon, 1994). It is understandable that students who do not have a lot of experience from collaborative learning, are not immediately able to adapt to situations in which they are required to share their thinking process with others. Recent cognitive research on computer-supported collaborative learning suggests that extended experience in collaborative learning fosters development of students skills of constructive groupwork (Koschman, Myers, Feltovich & Barrows, 1994; Scardamalia & Bereiter, 1994). In addition, the perceived nature of learning tasks seems to determine to a great extent the nature of interaction (Blumenfeld et. al., 1991). The reported studies indicate that participation in self-organised and open ended research-like study projects encourage free exchange of ideas between the students. Moreover, computers as mediating artefacts seemed to significantly foster communication between the students and provide a medium for students to interact even in absence of well-developed concepts for expressing their ideas.
References


Figure 1. An abstract description of the Piagetian model of social interaction (CC = sociocognitive conflict that interrupts the flow of social interaction; I = internalisation of the conflict; RC = process of resolving the conflict in the mental plane; ———- = discontinuous process of social interaction).
Figure 2. An abstract description of the Vygotskian model of social interaction (SCK = social construction of knowledge; CK = construction of knowledge in the mental plane; \(\rightarrow\) = continuous process of social interaction).