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ABSTRACT

Socioemotional processes of learning interaction during classroom teaching and learning were analyzed. The learning interaction was organized according to the principles of a cognitive apprenticeship model (Collins, Brown, and Newman, 1989) and applied to the technologically rich learning environment. The purpose of the learning task was to promote the mediation of modern technological thinking and problem-solving skills for 22 French male 7th-grade students. An on-line method was developed to analyze task involvement and motivational orientation during the instructional interaction. Data revealed that the same instructional arrangements are interpreted differently and lead to different situational interpretations among the students. Contextual features, such as the challenging learning task, self-responsible activities, and social interaction actualized different motivational coping strategies among the students. One figure illustrates the study. (Contains 63 references.) (Author/SLD)

COGNITIVE APPRENTICESHIP MODEL IN A TECHNOLOGICALLY RICH LEARNING ENVIRONMENT: SOCIOEMOTIONAL PROCESSES IN LEARNING INTERACTION

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Abstract

The study, discussed in this paper, analysed socioemotional processes of learning interaction during classroom teaching and learning. The learning interaction was organized according to the principles of a cognitive apprenticeship model (Collins, Brown and Newman, 1989) and applied to the technologically rich learning environment. The purpose of the learning task was to promote the mediation of modern technological thinking and problem-solving skills for 7th grade students. The aim of this paper is to analyse and describe students' socioemotional interpretations during the teacher-student and student-student interaction. An on-line method has been developed for analysing step by step the students' task-involvement and motivational orientation during the instructional interaction. With the help of explicit qualitative analyses the functioning of the cognitive apprenticeship methods as well as the role of the technologically rich learning environment will be discussed in terms of students situational socioemotional interpretations. The data show that the same instructional arrangements were interpreted differently and led to different situational interpretations among the students. The contextual features, such as the challenging learning task, self-responsible activities and social interaction actualized different motivational coping strategies among the students.

Introduction

Designing effective learning environments has been a challenge for learning researchers during the last decades. Recent research on modern learning theory has indicated that a learning environment should be managed differently in such a way that students are encouraged to set personal goals, plan their own learning activities, to actively gather meaningful information, to monitor and evaluate their own learning and to reflect personal learning experiences in authentic environments (Brown, Collins & Duguid, 1989; Glaser, 1987; Palincsar & Brown, 1984; Resnick, 1987; Resnick & Klopher, 1989). Consequently, new models of teaching and learning interaction have been developed (e.g. Collins, Brown and Newman, 1989; Palincsar and Brown, 1984), where the aim has been to find different ways to organize learning which facilitate the development of students' higher order thinking skills.

Today's intelligent technology, in turn, can contribute to the improvement of schooling, if it is appropriately embedded in powerful learning environments (Scardamalia et al., 1989; deCorte, 1990). The special environment can provide and facilitate structures and tools that enable students to make maximum use of their own intelligence and knowledge as well as offer meaningful and authentic contexts for problem solving (Cognition and Technology Group at Vanderbilt, 1991; Enkenberg, 1993; Reusser, 1992; Scardamalia, Bereiter, McLean, Swallow and Woodruff, 1989).

Cognitive apprenticeship (Collins, Brown & Newman, 1989) is an approach, which embeds learning in activity and makes deliberate use of social and physical context. The cognitive apprenticeship model has been broadly applied in empirical experiments in different domains (Farmer, Buckmaster & LeGrand, 1992; Guldimann & Zutavern, 1993; Johnson & Fischbach, 1992; Lajoie & Lesgold, 1989; Pieters & DeBruijn, 1992; Scardamalia & Bereiter, 1985; Volet, 1991). The model has been successful not only in promoting students' higher order thinking skills, but also in shaping the learning interaction from teacher-oriented teaching episodes to joint goal-oriented problem solving between the teacher and student. Although there has been evidence of successful outcomes, the qualitative analyses of the learning interaction are deficient, since earlier reasearch interests in cognitive apprenticeship learning have mainly focussed on learning outcomes or the strategic features of teacher-student interaction. Yet, qualitative understanding of the learning process is an important aspect, since the earlier research has provided evidence that 'cognition-only' models of student learning do not adequately explain why some students failure to activate or transfer appropriate knowledge and cognitive strategies (Brown, 1988; Brown, Brandsford, Ferrara & Campione, 1983). Instead, students' individual differences in motivational beliefs as well as classroom contextual factors may contribute to this problem (Pintrich, Marx and Boyle, 1993). Therefore, there is a lack of research, focussing on socioemotional aspects in learning interaction based on the ideas of new learning environments.

The research described in this paper examined the cognitive apprenticeship based learning interaction in a technologically rich learning environment. The focus of this paper is to qualitatively analyse socioemotional aspects of teacher-student and student-student interaction. Student's motivational orientation and task-involvement will be described. The functioning of the cognitive apprenticeship methods as well as the role of the technologically rich learning environment will be discussed in terms of students situational socioemotional interpretations.

The interplay of motivational, emotional and cognitive aspects in learning situation

When learning interaction is arranged according to the constructivistic theory, it involves the idea that school learning is cognitive, but also a complex social, emotional and motivational coping situation for a student (Levine, Resnick & Teasley, 1993; Perret-Clermont, Perret & Bell, 1991; Pintrich, Marx & Boyle, 1993; Vauras, Lehtinen, Kinnunen & Salonen, 1992). Traditional motivational research has examined cognitive or motivational components of student learning separately and socioemotional or situational aspects are usually ignored. Theorists have typically contrasted intrinsic and extrinsic motivational styles, viewing them as polar opposites as to characterize the child's general orientation to school learning. Easily the implication has been that such constructs are trait-like in nature. Thus, partial motivational concepts like the causal attributions of success and failure (e.g. Weiner, 1985) or the other strong extreme motivational states (e.g. Csikszentmihalyi, 1977; DeCharms, 1976) are not relevant to describe the whole socio-emotional and cognitive system of classroom interaction which, at the same time, is producing progressive development among some students and regressive coping efforts among others.

During this time, the emphasis in the study of motivation has shifted to social-cognitive approach, to an emphasis to how students construe the situation, interpret events in the situation, and process information about the situation. The approach assumes that self-beliefs and self-regulatory processes are crucial in explicating how an individual interpretes the meaning of and adapts to the social environment. Accordingly, the model assumes that students' motivational beliefs and self-regulatory processes may be situation-specific rather than traits of the individual (Dweck, 1986; Dweck & Legget, 1988; Harter & Jackson, 1992; Pintrich & Strauben, 1992). It seems that the level of cognitive engagement may vary as a function of individuals self-defined goals and purposes for the tasks as well as their beliefs about the tasks and themselves (Pintrich and Strauben, 1992). In order to understand students' learning in social situations and performance in complex problem solving a closer examination on the motivational constraint of student's goal orientation and self-beliefs is needed.

Goal orientation refers to the student's reasons for learning as reflected in his or her approach to the academic tasks. Two basic goal orientations have been identified, although named differently by different researchers: ego orientation vs. task orientation (Nicholls, 1984), performance orientation vs. learning oriention (Dweck, 1986), and extrinsic orientation vs. intrinsic orientation (Harter, 1981). The two approaches distinguish between students who view learning as a means of performing better than others without intrinsic interest to learn and students who value situations that will enable them to expand their knowledge and skills (e.g. Dweck and Leggett, 1988; Elliott and Dweck, 1988; Nicholls, 1984). To goal orientation, an important expectancy component is self-efficacy, which is defined as students' judgments of their capability to accomplish a task in a specific situation (Bandura, 1986). The focus of human functioning is then viewed in terms of reciprocal intentions among behaviours, environmental variables, cognitions, emotions and other personal factors.

To form a more complete model of the interaction of students' motivational, emotional and situational interpretations in learning a systemic approach to classroom learning has been developed. (Lehtinen et al., 1993; Olkinuora & Salonen, 1992). In their approach Lehtinen et al. (1993) base on the assumption that learning, as a constructive process is subordinate to a larger goal-oriented activity system of the student. The activity system can be described in terms of subjective coping efforts which are influenced by the challenges and possibilities of the environment and by the socioemotional, motivational and cognitive interpretations made by the learner. In a concrete learning situation, involvement in learning, quality of the learning strategies and metacognitive strategies are related to subjective interpretations of task demands, personal meaningfulness of the content, and the quality of social situation. From another perspective, the social and motivational interpretations of learning situations are influenced by the learner's emotionally important experiences from his or her earlier learning history and the quality of learning strategies available for the learner in that particular domain.

In the model (Olkinuora & Salonen, 1992), **task-orientation** is indicated by the child's intrinsically motivated task-approach tendency and persistent striving for mastery (cf. Csikszentmihalyi, 1977; Harter, 1975; 1981). The student interprets the teacher's perspective of the task as means of correcting and reorganizing his own assimilation of the task. He is sensitized to novelties, ambiguities, inconsistencies and other challenging aspects of the task. One of the defining characteristic of task-orientation is a self-regulated mode of action, which genesis could be explained by students' individual and spontaneous exploratory action (Piaget, 1978) or under the relevant guidance of adults in a social context (Vygotsky, 1978). **Social dependence orientation** is characterized by the student's teacher-related approach tendency and his continuing attemps to comply with the teacher (Harter, 1981). The student's interpretation of the situation is concentrated on following the teacher's momentary behavioural cues and responding to the social demands in an appropriate way. This is guided by the motive of social approval. **Ego-defensive orientation** is indicated by the child's avoidance tendencies and behaviour manifesting emotional conflict. The child is sensitized to situational factors suggesting threat or risk, experiencing his ego rather as an objectlike entity than as an active agent. Novelties and ambiguities will not be interpreted as interesting starting points for exploratory activity or for cognitive elaboration (Nicholls, 1984).

Within the last decade, a considerable body of empirical research and theory has shown the link between student motivational orientation and cognitive engagement in schoolwork. The studies have shown that higher levels of self-efficacy, adoption of a mastery goal, beliefs that school work is useful, interesting and worthwhile, and lower levels of test anxiety seem to result in the use of more cognitive and metacognitive strategies as well as persistence and effort at school tasks (e.g. Ames & Archer, 1988; Pintrich, 1989; Pintrich & DeGroot, 1990; Pintrich and Garcia, 1992; Pintrich and Strauben, 1992 Schunk, 1985). As Pintrich and Garcia (1992) state, motivational beliefs can foster the development of intentions to learn, and cognitive and self-regulatory strategies are the tools by which students actually learn and maintain their intention to learn.

Contextual aspects on students motivational orientation

The introduction of more cognitively complex tasks, which provide opportunities for solving real problems in authentic contexts has become the aim of school tasks in the course of the situated cognition paradigm (Brown, Collins & Duguid, 1989; Resnick, 1987). Moreover, project-based learning is suggested to increase student interest and enhance deeper understanding (Blumenfeld, Soloway, Marx, Krajcik, Guzdial and Palincsar, 1991). The result of an such approach is supposed to be that learners are motivated to persist at authentic problems, meld prior knowledge and experience with new learning, and develop rich domain specific knowledge and thinking strategies to apply to real-world problems.

Several factors, however, may affect students' perceived and actual competence as they engage in complex projects. First, students need to have sufficient knowledge of the content and specific skills to explore information pertinent to the problem. Second, students may become frustrated if they lack the necessary knowledge and skills, the problems become too complex, or the solution is too difficult to demonstrate. Third, students need to be able in using cognitive and metacognitive skills to generate plans, make predictions and interprete evidence (See Chipman, Segal & Glaser,1985).

Recent research has pointed out how technology can play a powerful role in enhancing students' motivation and knowledge construction. It has suggested, for example, that technology can enhance students' interests, make information more accessible, help the exploration, manipulation and construction of students' own representations or to provide tactical and strategic support (Lehtinen & Repo, in press; Blumenfeld et al., 1991; Reusser 1992; Scardamalia, Bereiter, McLean, Swallow and Woodruff, 1989). For example, motivation is enhanced by anchoring instruction in meaningful and authentic problem-solving contexts in computer based learning environments (Cognition and Technology Group at Vanderbilt, 1991).

Evaluating cognitive apprenticeship model and students motivation

In the cognitive apprenticeship approach (Collins, Brown & Newman, 1989) the following guidelines are important with a view to realizing a favourable social context for learning. In a respect of situated learning idea (Resnick, 1989; Brown, Collins & Duguid, 1989) students should be given tasks and problems representing the diversity of situations to which they have to apply their knowledge and skills afterwards. The master-apprentice relationship is used as an analogy for the teaching-learning situation. It is argued that, like masters, teacher's should scaffold instruction to teach strategies for thinking and problem solving and gradually transfer responsibility to learner. In constructivistic learning environments, as the cognitive apprenticeship, motivation is then supposed to come from attempts to complete authentic tasks, social interaction, personal dissatisfaction with current conceptions, and recognition of the superior exploratory power of new ideas (Blumenfeld, 1992; Pintrich et al., 1993).

There are, however, small or even no empirical findings or theoretical discussions concerning the cognitive apprenticeship method's contribution to students motivation, except the demand of increasing intrinsic motivation supported by the cognitive apprenticeship methods, as presented by Collins, Brown and Newman. Closer examination of the instructional arrangements in cognitive apprenticeship reveal that most of the ideas presuppose at least some amount of task-involvement for a learner. Students' own responsibility for learning, active participation and student's own construction process is needed.

The three main techniques in cognitive apprenticeship are based on observation, guided and supported practice, and feedback aiming at the acquisition of cognitive and metacognitive skills. *Scaffolding* and *coaching* consist of providing direct support on the right current skill level whilst a student is carrying out the task, and then gradually fading the assistance (cf. Vygotsky, 1978). Ideal scaffolding situation is supposed to contribute to high task involvement and intrinsic motivation and similarly to create more independent learners. Yet, the scaffolding process may have some preconditions to work as it is supposed to. A student needs to be involved in a task, so that the teacher is able to get into that process and give his assistance (cf. Palincsar and Brown, 1984). That means, it may be that scaffolding has different effects on students depending on their motivation in the situation. As Vauras, Salonen and Naskali (1992) found in their extensive cognitive-motivational intervention study, scaffolding does not seem to succeed optimally with students having strong non-task-oriented coping tendencies. According to them, some students manifested growing amounts of ego-defensive behaviour as function of increasing demands for self-regulation. Moreover, the increasing requirement of independent performance and external guidance may lead to inhibition, defensiveness or growing reliance on external support as it has been found in studies among learning disabled students (see Olkinuora and Salonen, 1992).

The *modelling* situation is supposed to give models of expert performance. This doesn't mean only an expert's internal cognitive processes, like heuristics and control prosesses, but a model of expert's performance, motivational and emotional impulses, in problem solving (Schoenfeld, 1985). In order to be able to follow the teacher's modelling it can be suspected that a student must have certain cognitive abilities and motivation. It can be supposed that to be able to move from the superficial level to the deeper level of understanding the conscious co-constract with the teacher's model of thinking is needed. For example, a student may have a personal desire to solve the problem or previous attempts at solving the problem, which wake his or her interest in following the teacher's approach.

Guiding students to *reflection* on the learning process is assumed to enable students to compare their own problem solving processes with that of an expert, other students, and ultimately, an internal cognitive model of expertise. To be able to reflect, and benefit from that, metacognitive skills are needed. When a student is able to metacognitive thinking, his reflections along with the expert's or classmate's performances may either strengthen or weaken his motivational involvement to continue the process. Positive self-cognitions may increase self-efficacy, whilst negative self-cognitions may decrease it.

The hypothesis of this study is that the interaction of cognitive, motivational and emotional observations is significant in students' learning. That means, in accordance with Dweck's (e.g. 1986) model of motivation study, that students' beliefs about themselves and the task or classroom environment act as mediators of their behaviour, and accordingly, may be situation-spesific rather than traits of the individual. In this study the learning interaction was organized according to the principles of cognitive apprenticeship and applied to the technologically rich learning environment. In the qualitative analysis attention was especially paid to the situational aspects of the teacher-student and student-student interaction. In this paper the purpose is to describe *the students' motivational orientation and task-involvement during the learning interaction based on the cognitive apprenticeship*. It also focuses on evaluating *how using the cognitive apprenticeship model, especially the three essential methods scaffolding, modelling and reflection, effects students' situational motivational and emotional interpretations in a technologically rich environment.*

Method

Subjects

The subjects of this study were 22 boys from the seventh grade of the upper level of a Finnish comprehensive school, aged thirteen or fourteen years. Eight of the students were assigned to the qualitative analyses. The experimental lessons were part of the boys' normal technical handicraft course. Two classes, selected from four possible ones, were assigned the experimental lessons. They were chosen because the students in them were very heterogeneous in their practical and theoretical skills, as estimated by the technical handicraft teacher together with the teachers responsible for the classes.

Procedure

The learning task

In the experiment a legologo environment was used for mediating modern technological thinking and problem-solving. The aim of the learning environment was to promote mediation of the thinking skills and heuristic processes of an expert working in a complex technology environment. The object of learning was to investigate and model the control technological principles of an automatic washing machine. The structure and functions of the washing machine were simulated by means of control technology. Students constructed and programmed a physical model for the automatic washing machine. Logo programming language (Papert, 1980) was used for programming and lego bricks (Technic Lego for computer control) for constructing the model. During the planning process of the program, students used different extrinsic cognitive tools, like tree diagrams, in order to model the complex structure of the control problem (For more details of the project see Enkenberg, 1993; 1994).

Structuring the learning environment

The experiment consisted of three lessons held in a computer classroom. Each lesson lasted three hours. The students worked in pairs to programme a model for the automatic washing machine. Students chose their partners themselves at the beginning of the lesson. Neither the researcher nor the teacher influenced the situation, but asked the students to form peer groups. The learning interaction was based on the principles of cognitive apprenticeship. The teacher in this experiment was an experienced researcher. He was chosen because of his strong theoretical knowledge of cognitive apprenticeship and practical teaching experience in the legologo environment. This was important because although the learning environment and the learning task were closely argued and planned, there were no formal structured didactical plans for the use of cognitive apprenticeship methods; the teacher was free to use, for example, modelling when he decided that it would be relevant.

Describing the learning task and the implementation of cognitive apprenticeship principles

The whole project progressed as follows. Before beginning the project the students were asked to become familiar with the observable structure and operations of the automatic washing machine at home. The first class started with a discussion supervised by the teacher on the mental models the students had constructed on the basis of the work at home. In the same situation the structure of the washing machine and the phases of the washing program were modelled with the help of a tree structure. Soon after this the students started to build a model of the automatic washing machine using lego bricks. This phase was supported by an instruction booklet.

After completing their models, the students connected them to their computers and started to *explore* the operations of the model and, at the same time, to study logo programming language. For this the students had received written material to work on. The aim of this activity was to learn how to make the model function by giving commands to the different parts of the model such as motors, lights, or sensors. Having learned the basic logo commands, the students started to plan how to program a whole washing program. The teacher, discussing with the students and thinking aloud, *modelled* the structure and actions of the washing machine once again. The aim of the *global modelling* was to mediate a general thinking model.

After planning and implementation into the logo-environment had been modelled, the students started to structure their own programs, working in pairs. During this phase the teacher attempted to *scaffold* learning in different indirect ways in order to enhance further progress. Similarly, as the students learned to program, the teacher gradually *faded* away. When problems emerged and the teacher discussed with the students, he attempted to stress the development of metacognitive thinking and *reflective* questioning. Then the *situation-specific modelling* was also presented by the teacher with the aims of enhancing situation-specific skills.

At the beginning of the last lesson the students were given the actual project assignment. The students had almost three hours to complete the project task, the goals of which were to plan and program a model for an automatic washing machine, which had to fulfil certain conditions, such as that the model had to correspond to the students' conception of the procedures of some of the washing programs as well as possible. The idea was that students *articulate* their knowledge and aim at a more independent working process.

The data collection

Method for on-line research

In order to analyze the quality of the learning interaction, three lessons in two classes were videotaped in a certain way. Special video technology was used, where the display card interpreted the computer screen as video signals. This made it possible to get a simultaneous videotape of the interaction and also a real time videotape of the screen. All the elements of the situation: videotaped interaction, voice and real time videotape of the screen (see Figure 1.), were combined on one complete tape. The data were collected by videotaping four randomly selected pairs of students working so that it was possible to follow the interaction between students and the interaction between the teacher and students. The whole classroom situation with all pairs of students was also videotaped to get evidence of general classroom events, such as students' movements.

Stimulated recall interview

After each session, four pairs of students were interviewed. The interview was carried out using a stimulated recall method (Bloom, 1953), letting students watch the tape where they themselves are programming (See figure 1.) The interview was performed as soon as possible after the lesson. Before that the researcher watched the videofilms herself and chose the most relevant episodes for the interview. The selection of the episodes was made according to the theoretical principles of the cognitive apprenticeship method which were used in the study. The purpose was also to select episodes from the beginning, the middle and the end of the lesson. In the interview the students were asked to describe spontaneously, whilst watching the tape, their feelings and thoughts about the interaction. Some questions were presented concerning the teacher's modelling and scaffolding, for example. On the tape, where all the elements of the interaction were connected, students were able to see their actual cognitive work concretely on the computer screen and, in this way, their mental processing was reflected as external interaction.

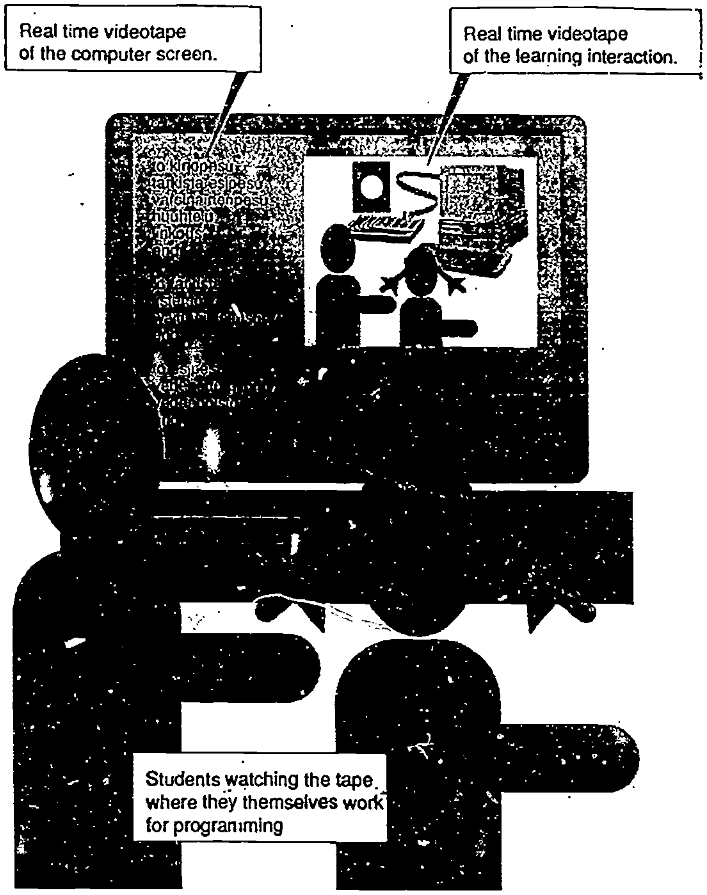

Figure 1. A stimulated recall interview situation

The data analysis

When analyzing the data the ideas of content analysis (Chi,1992; Patton,1990) were followed. First, immediately after the lesson, the video material was carefully watched by the researcher and the episodes for analysis were segmented from the videotapes. Episode boundaries were defined in the context of the research questions and theoretical principles. The idea was to find episodes of the lessons when elements of the cognitive apprenticeship method in learning interaction and the students' individual behaviour and situational interpretations were observable. Immediately after that, the episodes were used for the stimulated recall interview. Next, the episodes were transcribed. Before the analyses, smaller units were grouped together and completed with the interviews. The analysis progressed so that the first analysis was done according to the cognitive apprenticeship method's functioning, and in the second analysis, the students' situational behavior was interpreted. It is important to notice that the analysis aims to describe students' situational behaviour and interpretations during the experimental lessons and is based only on the videodata and the interviews.

The qualitative on-line research method was chosen to provide access to multiple interpretations of the learning situation and, at the same time, to provide valid information of the situation. The video technology of the present study made it possible to get data not only on students' verbal and nonverbal interaction, but also on their cognitive processes. The stimulated recall interview was supposed to increase the validity for analysing students' thought processes (cf. Ericsson & Simon, 1980). The method gave rich and relevant data for the study. However, some problematic decisions were involved in the data analysis. Having more than one person to estimate the relevancy of the episodes selected from the videotapes would have increased the validity. However, we may suppose that using the theoretical principles as selection criteria are relevant enough for the validity.

The examples, the transcribed video episodes and interviews, aim to demonstrate students' situational interpretations during the experimental lessons. The analysis do not base on any earlier measurements of students' motivating or orientation tendency in classroom situation, but is based on students' situational tendencies during the experiment lessons.

Results

The data show that the students interpreted the learning interaction in qualitatively different ways. It seems, that the relevant explanation for this could be students' individual ways to cope with challenging learning and performance situations involved in the present study, which leads to the need to consider the students' different interpretations in the light of motivational orientation (cf. Olkinuora & Salonen, 1992).

Students' task- involvement and motivational orientation during the learning interaction based on the cognitive apprenticeship

The qualitative data reveal that there were students characterizing *task-orientation* in the experimental lessons. They demonstrated intrinsic interest and desire to solve the problems of the learning task. The developmental dynamic of the task-oriented students' motivational involvement during the process was increasing and thus dominating during the lessons. Their work was very goal oriented, and when the challenge increased, their involvement remained or even strenghtened. Episodes 1. and 2. describe the students' involvement at the beginning of the project and at the end of the project.

Episode 1.

Olavi: Type in "talk to 3 onfor ..." (Hannu types this in. Both boys seem to be concentrating hard.)
Hannu: Look, that's the time! (Appears enthusiastic.)
Olavi: All right! (Types in "talkto 3 onfor 20)
(Both boys follow what is happening in the washing machine.)
Olavi: Sir, I've got the time here! (turns around excitedly to look for the teacher and points to the display. The teacher is not close, though. Hannu looks puzzled and reads the task sheet.)
Olavi: Hey, type in "talkto 4 onfor" ... . Hey, hold on, now I know! This is a really good one! See, "talkto" ... Where's the motor? (tries to find help in his papers whilst Hannu follows him.)
Hannu: It's "A"!
Olavi: (Continues programming.) "Talkto A onfor 10". (There is the following message on the display: "I don't know how to A" and nothing happens.)
Hannu: It should be zero!
Olavi: No, it shouldn't. No way!
Hannu: (Types in "talkto 0 onfor 10" and the motor starts .)
Olavi: What?!
Hannu: It's in the port 0. Just leave it. (Looks pleased with himself.)
Olavi: (Types in "talkto 0 onfor 50" and the motor runs.) Hey, Jani! See what a brilliant program we've got here! (Turns around to the boy sitting next to him and shows the model of the washing machine to him.)

Researcher's interpretation:

It is the first lesson of the project. Students are testing how the model works with logo-orders. They are sitting very close and are bowed over the computer. When they discover the meaning of time in the program, they both look very enthusiastic. Especially Olavi is inspired and his facial expression reveals his eagerness to continue. He also spontanuously wants to report their discovery to the teacher and to other students, but he does not need any response to that. He immediately continues programming. In general, students interaction is directed through the work and it seems that their involvement in the work is getting deeper, which is possible to see in the interview also.

Interview:

*Interviewer:*How did it feel to discover how the computer program works?
Olavi: Well, you sort of get carried away with it. You have to try it out there and then.
Interviewer: What about you Hannu?
Hannu: I agree with Olavi. You just want to try it out and make it even better.

Episode 2.

(The boys are planning music for their program. There is a break at the moment but the boys do not want to have a break so they continue working.)
Olavi: Right, ... a,g, f, e and type there "wait"!
Hannu: You don't put "wait" there!
Olavi: Yes you do. Otherwise it won't play it twice.
Hannu: Really? It won't?
Olavi: No, it won't. We tried that last time.
Hannu: Well, what's this called? Let's type here "end" and try that.
Olavi: That's the language.
(There's music coming out now and the boys look pleased.)
Olavi: Hey, wasn't it supposed to play the music for six seconds. (The boys continue their work eagerly. Olavi hums and taps the rhythm. Hannu types this tune into the computer.)
Olavi: Now type in "wait"! Or, maybe we'll do it like this ...(Sings, gestures and laughs in between.)
Hannu: Then it goes like this ... (Concentrates on inputting the information onto the computer.)
(The boys continue their music making. Joni comes over to see them work. He watches them for a whilst but the boys ignore him.)
Joni: Hey, play that one!
(The boys run the program, Joni watches them working and then leaves. The boys continue without interrupting their work.)

Researchers interpretation:
It is the last lesson of the project. In this situation intrinsic interest characterizes students' work and involvement. Both of the students are taking responsibility for the work and their emotional involvement in the work also has some joint features: enthusiasm, satisfaction and deep concentration. However, they have personal forms of how that socioemotional involvement occurs. When Olavi presents his involvement with plenty of cues and talk, Hannu sits quietly thinking. It's also typical for him to be more critical towards his own work and processing. In the end of the episode it is possible to see students' high involvement, close to "flow" (Csikscentmihalyi, 1977). When another student comes to see their program, they hardly pay any attention to him, but continue their work.

Interview:
Interviewer: What did you think about when the lessons finished?
(It had been the last working session.)
Olavi: Well, it was a shame it was the last time.
Interviewer: Hannu, what were you thinking about at the end of the lesson?
Hannu: Well, it was sort of depressing because there wasn't any more things to do and I think we'd been told that we could make our own constructions and things, and then we could program them. But then the teacher said that it won't be until spring that we'll get to do that.

Having a learning goal orientation (Dweck, 19?6) and a high sense of self-efficacy (Bandura, 1982) the students seemed to enjoy the work and cognitive challenge, as seen in their expression in the interview. *"I should realize by myself.", " It's better to have an own approach."* Students task orientation may have even strenghtened during the working process. The growing task-orientation positively affected the quality of cognitive and metacognitive strategies as well. They emphasized the need to understand by themselves, felt satisfaction of a successful performance and analysed their aims in problem solving. That is seen in episode 3., which is an example of Tuomas's metacognitive thinking whilst solving a problem.

Episode 3.
Tuomas: So where does this start then? (Thinks aloud.) It's the language. Then I'll put here "if time >". What was it now?... "40" [stop] ... Oh, but it won't have enough time to play this in forty seconds!
Teacher: What's the problem, then? (Bends closer.)
Tuomas: The program's too long.
Teacher: That's right.
Tuomas: I suppose I could fit it into ten seconds...
Teacher: That's right.
Tuomas: Or maybe I could change its place?

In general, the students' motivational orientation in the experiment lessons supports findings that students' cognitive engagement in school learning is affected by the relevancy of self-efficacy, goal orientation and task value (See e.g. Pintrich, 1989; Pintrich and Garcia, 1992; Pintrich and Strauben, 1992; Schunk, 1985). The notions of the data of the task-oriented students seems to be in accordance with Schunk's (1985) conclusion, that motivated learning is characterized by an interactive relationship between self-efficacy and learning experiences. Moreover, from Piagetian perspective (Piaget, 1978), the creation of internal motivation presupposes the formation of an optimal conflict, which refers to that the students' tolerance of ambiquity is relatively high.

There were also students characterizing *non-task-orientation* in the experimental lessons. Among them many contradictory effects were observed during the lessons. These were related to social-dependency and ego-defensive coping strategies (Olkinuora and Salonen, 1992). However, strong generalized motivational orientation was not dominating among non-task-orientated students, but coping-tendencies were actualized according to the students' situational interpretations. At times these students were highly motivated and they were able to benefit from the teacher's assistance, at times there was a total lack of motivation.

The developmental dynamic of the non-task-oriented students motivational involvement was unsteady. From the first lesson to the last lesson their involvement varied a lot. They did not had reasonable goals in their working process and if they had some, they were not able to maintain effective and continuous striving toward these goals. Episodes 4. and 5. are describtions from the second lesson. The former is an episode where the teacher's positive feedback has inspired students' involvement, whilst the latter is an episode recorded later during the same lesson where students are completely unmotivated. The students represented during the experimental lessons typical dispositions of social dependence orientated student: unsureness of own capabilities and tendency towards help-seeking (cf. Harter, 1981; Lehtinen et al., 1993). Because of their disconnected involvement in work, their cognitive development was not continuously and consistently constructed, but they started their cognitive processing from the beginning every time and mostly not without the help of the teacher.

Episode 4.

Teacher: You don't need to press "enter" at every point.
You can move along the lines and continue like this. Okay?
Pekka: Uhm.
Antti: I'll put the time unit here. Let's say 90. (Looks at Pekka.)
Pekka: (nods)
(The motor starts rotating and the boys look excited.)
Pekka: It rotates now!
Antti: And it goes on for a long time! We put in there "onfor" 90 and it'll rotate for a long time! (Calls the teacher.)
Teacher: How many seconds have you got there?
Antti: I don't know ... maybe one and a half seconds.
Teacher: How many?
Antti: No, no, wait ...
Pekka: One and a half minutes.
Teacher: Is it?
Antti: No, that's not right.
Pekka: It's ninety, so it is one and a half minutes. One minute is sixty.
Teacher: How many seconds are there in two minutes?
Pekka: 160, no... 120!
Teacher: Right, it's going well. (encouragingly)

Researcher's interpretation:
Students are testing the model. They get it function with the help of teacher's scaffolding and appear enthusiastic. That inspires their work. It seems that to progress in their work their own ideas needed some kind of encouragement from the teacher.

Episode 5.
(The boys are at their desks. They are talking and drawing pictures.)
Pekka: Antti's picture is easy to draw because he looks so stupid!
Antti: (Laughs and types in some words.)
Pekka: Hey, Juhis, what time are we going to play ice-hockey? I get back at six...
(The situation continues on these lines and the boys talk about ice-hockey.)
Researcher's interpretation:
The students motivational involvement has evaporated. They are only talking about their own private things and joking. In the interview they said that they were tired of working.

Interview:
Interviewer: What did it feel like in that situation?
Antti: Well, I started to get bored with that stuff, really.
Interviewer: Why wasn't the making of the program interesting anymore?
Pekka: Well, because we didn't get ahead with it.

It was typical, that the students' positive situational interpretations often increased their motivational involvement. When the students felt that they had progressed or properly understood, they get more inspired and involved in work, which is seen from their expressions in the interview below. An unsolved problem was discouraging, but progress caused positive situational interpretations as evidenced in the interview below.

Interviewer: How did it feel to do the work? Were you interested in it?
Pekka: At first it wasn't interesting but when I understood a little bit about it and I started using the program so that the lights were working and all, then it got better.
Interviewer: Antti, were you interested in the work?
Antti: Not really. But it gets more interesting when you get something working.
Interviewer: Were you interested in the work at that point, Pekka?
Pekka: Yes, I was. I really got into it here.
Interviewer: INT: Do you know why?
Pekka: Because I learnt how to do the commands and I got them working.

Confronting obstacles and feeling insecurity in problem solving led to negative situational interpretations among non-task-oriented students. They were associated with negative self-cognitions and social-dependence or ego-defence coping attemps were aroused in the course of the decreased involvement. This refers also to maladaptive, helpless orientation, which is characterized by low persistence in the face of difficulty (Dweck, 1986). Episode 6. describes a situation where social approval is seeked by cognitively irrelevant performance. Episode 7., following the situation in episode 6., is an example how teacher's support and approval increase students' involvement.

Episode 6.
Pauli: "To" coloured wash.
Jukka: (Types in.)
Pauli "To" prewash.
Jukka: Uhm.
Pauli: "To" wash.
Jukka: And then...
Pauli: "To" rinse. This is the stupidest thing ever! (frustrated)
Pauli: You need a space there!
Jukka: Oh, OK. And then what? "To" spin?
Pauli: Uhm.
Jukka: (Types in "end".)
Pauli: Erase all that up to that prewash. Erase it!
Jukka: : Oh, you want it erased...

Researcher's interpretation:
The students wrote random orders on the computer screen. They admitted that they didn't understand what to do, but just made up something. In this situation the reason they didn't understand effected their emotional and motivational involvement. They were frustrated and irritated by the situation, which made them unsure of themselves, and they didn't bother to seriously try or take responsibility for their own learning.

Interview:
Interviewer: Jukka, what are you typing in?
Jukka: What Pauli told me to type in. I didn't understand it.
Interviewer: How did it feel not to understand what you were typing in at that moment?
Jukka: Well, I just thought that I'll get something done.
Interviewer: How did you feel in that situation?
Jukka: It felt really stupid.
Interviewer: Pauli, so what were you thinking?
Pauli: I thought that that's what we should try to do. It wasn't going right but it didn't matter.

Episode 7.
Pauli: Type in wash.
Pauli: Teacher, does it go like this? Do I type in wash next?
Teacher: Yes you do. Like this, for example.
Pauli: Okay, now it starts working.
Jukka: What do I do now?
Teacher: How would you define the wash? What phases does it have?
Pauli: Then we do this! (Enthusiastically) If the prewash and wash are similar then we need only one definition. Is that right?
Teacher: That's one alternative. Yes, that's not a bad idea.
Pauli: Why is there a space there? Hey JP, delete those spaces. Do we always have to leave those spaces there? (Addresses the teacher.)
Teacher: Not necessarily.
Pauli: Okay then, "to wash", water intake (Jukka types in), spin, water outlet ...

Researcher's interpretation:
Jukka, as usual, is not willing to take any responsibility for the work. He only passively enters Pauli's orders. Pauli wants to try, but he doesn't trust himself and needs the teacher to accept his ideas. In this case his scaffolding seems to stimulate Pauli's enthusiasm about the task.

The data concerning students characterizing social-dependence and ego-defensive orientation in the experimental lessons is close to the other research findings demonstrating how value components of students' motivational goal orientations are related to students' approaches to learning, persistence on difficult tasks, and intrinsic motivation (Elliott and Dweck, 1988; Dweck and Leggett, 1988).

The students' situational socioemotional interpretations of learning interaction based on the cognitive apprenticeship

The essential methods of cognitive apprenticeship model, scaffolding, modelling and reflection worked very well between the teacher and the task-oriented students in terms of reciprocal interpretations, task involvement and increasing self-directness. It turned out that the students had an individual heuristic approach towards the complex tasks, which was independent of the immediate social interaction offered by peer or the teacher. Hannu's next comment of the situation where the teacher comes to the students reveals his individual heuristic approach: *"Well, the teacher comes and interrupts everything just when we were getting into it. He comes and confuses everything."* Thus, scaffolding discussions with the teacher formed to be more like joint goal oriented problem solving, where the interactors indicated a real interest to solve a complex problem. Episode 8. is a typical scaffolding discussion between the teacher and the task-oriented students demonstrating reciprocal motivational involvement.

Episode 8.
Teacher: The problem is, that when it stops here ...
Tuomas: Uhm.
Teacher: ...it'll return to the previous procedure, which then calls ...
(the boys are intensely following the teacher.)
Tapio: Why's that? I mean, time's here (points with his finger).
Tuomas: Yeah. how can you make it stop?
Teacher: Well, the problem's here, you see... I don't know how to solve this.
Tuomas: I mean, I was just thinking that if you put here, like, the end in parathesis and then end and "onfor 40".
Teacher: Uhm.
Tuomas: No, no, I mean "to" end and "onfor 40".
Tapio: What? It's going to end at four seconds.
Tuomas: (Laughs.) ...and it'll go nuts! Right! So, I just put here end and then "talkto a", let's say "onfor 40". (Types it into the computer.)
Tapio: Then the motor should rotate for four seconds.
Tuomas: That's right. Will it restart after that?
Teacher: Well, there may be a couple of problems left ...
(They all try the program out.)

Researcher's interpretation:
The teacher and the boys are solving a problem together. The teacher indicated that the problem is difficult to solve, but still they are highly involved in solving it, even it is an end of a lesson. It seems, that all the interactors are equally contributing to the joint aim.

Interview:
Interviewer: Tapio, what's happening here?
Tapio: We've got a problem there on that program and we're trying to solve it with the teacher.
Interviewer: Tuomas, can you guess what the teacher was thinking about at that point?
Tuomas: Well, we'd done that pretty well, so I guess he thought we were quite good at it.

The teacher's *scaffolding* was necessary for the students with a tendency toward social depence orientation. They were not able to begin their cognitive work without help and assistance was needed when they met some difficulties. Overall, the teacher's scaffolding was necessary not only cognitively, but especially emotionally to encourage their involvement. It appears from the data that scaffolding discussions between the teacher and the students inspired students' motivational involvement, but that was only for the duration of the teacher's help. During the fading phase the students were not able to increase their self-directness. It seems, that the students became gradually more and more dependent on teacher's guidance during scaffolding discussions. It is possible to suspect, then, that teacher's regular scaffolding even increased students' social dependence coping strategies. Episode 9. is an example of scaffolding discussion between the teacher and non-task-oriented students.

<u>Episode 9.</u>

Pauli: There's some problem there. It starts off but if you open the door it won't close until you type in "off".
Teacher: Uhm. *Should we do it like this?*
Pauli: I don't know. I suppose it shouldn't do that. It should say: "a" port and then it should listen to the six and then wait...
(Jukka talks with the boy next to him and does not pay any attention to the work.)
Teacher: I wonder how we should solve this so that it wouldn't get interrupted?
Pauli: Yeah, and then start it up.
Teacher: Yes. Or, for example, start it up if ... *Does it rotate the wrong way round?*
Pauli: Yes, but ...
Teacher: Then we could try this...
(Both of them try it out and observe the functions of the model. Jukka starts to show some interest in the work as well.)
Teacher: There's still a problem of getting it to ...
Jukka: ...to stop! (After following the teacher and Pauli working on the program Jukka starts to get exited about the work.)
Teacher: That's right. How can we do that? Well, this is a good one. Let's have a look here. There's the word "waituntil" which we can use. Could we use it twice? (The boys think about the question.)
Pauli: That means it'd take ...
Teacher: Let's continue from here. Type in "waituntil" there. How would you continue it? Good! This is a hard one to crack.
Pauli: "Waituntil off"...
Teacher: And then comes sencor and ... I wonder what the mode should be? Think about that.
Pauli: It should be "false", of course!
Teacher: Great! Let's try that. I'm not sure if it'll work. Do you think it'll work?
Jukka: I think it should work now.
Teacher: Well, try it. Press "enter"... All right, now it works again.
Pauli: We should still have something that makes it continue working!
Teacher: Yes, that's true, but let's save that one for the next time. This one's pretty good, isn't it?
Pauli & Jukka: Uhm.

<u>Researcher's interpretation:</u>

Pauli is trying out the program, but he needs the teacher to help. Jukka concentrates on his own constructions, he is not involved in the work. It seems that Pauli is a bit unsure of taking responsibility of his own learning. Pauli has an active scaffolding discussion with the teacher. In the end of the episode Pauli's self-directness has increased and also Jukka has got involved in work. The interview, however, reveals strudents' extrinsic orientation.

Interview:
Interviewer: Pauli, what did you think when the teacher was helping you? How did he help?
Pauli: Well, he sort of tried to get me to think.
Interviewer: Is it a good way?
Pauli: Rather good, but I would prefer that he would tell streightly the point. I would be easier.

Interviewer: What are you thinking Jukka?
Jukka: I'm thinking how could I fix caterpillar tread to my gadget.
*Interviewer:*INTERVIEWER: You were not interested in the programming work?
Jukka: Not any more.

During the lessons, the teacher used global *modelling* in front of the class and situation specific modelling in interaction with the student peers. The task-oriented students quite easily assimilated the mental processes carried out by the teacher. Instead, because of task-oriented students' high sense of self-efficacy and self-directness, they were not automaticly willing to accommodate the teacher's model of thinking, which can be observed from the interview below.

(the global modelling)
Interviewer: The teacher seemed to be explaining his own thoughts there. Did you find that useful? Why do you think he's doing that? Hannu, what's your opinion?
Hannu: Well, he was sort of trying to make us understand, but I found it bad that he's trying to make us think like he does. I'd just want to get some basics and then we'd be left to think about this by ourselves; and then we'd figure it out that way.
Interviewer: Olavi, did you get any ideas from the teacher?
Olavi: Well, I suppose I did but it'd be better to sort of understand it by yourself and not to have the teacher explaining it all the time.

(the situation spesific modelling)
Interviewer: Olavi, what happens now?
Olavi: Well, he explains how the program works and what it consists of.
Interviewer: What were you thinking at that stage?
Olavi: Well, I thought I sort of understood it.
Interviewer: Were you interested in following the teacher on that occasion?
Olavi: Well, I don't know really, I already understood the thing, and the teacher kept on explaining and I got bored...
Interviewer: What were you thinking on that occasion Hannu?
Hannu: Nothing really...
Interviewer: Was everything clear to you then?
Hannu: He was explaining those things, which I understood already.

During the global *modelling* episodes the non-task-oriented students were not co-constructing the problem-solving process carried out by the teacher. They were rather waiting for concrete hints for the next step. For some students self-responsible working periods as such were experienced as frustrating and consequently, ego-defensive coping attempts were aroused as demonstrated in episode 10. Instead, situation specific modelling was experienced more reciprocally, when the modelling performed by the teacher was directed to the actual problem the students had. The next episode is also a good example of an actualization of students' coping tendencies as a basis of their situational interpretations.

Episode 10.

Teacher: Here we're faced with various choices. Super wash, for example. What does that mean? This is rather complicated... Prewash, rinse and then we've got delicates, coloured wash, temperature, and the spin's there. So, all these things appear here. How could we define this washing programme clearly? This is fairly good but it's not sufficient for our use... (thinking) Maybe we should try to think about the possible main phases that are here when we continue. Use that to work with.

Researcher's interpretation:

The teacher is modelling in front of the class. The students are sitting and observing the teacher. It looks like Pauli follows with consentration, but the interview revealed this not to be true. Jukka's concentration is more disconnected. The interview reveals students' socioemotional problems.

Interview:

Interviewer: Pauli, what did you think about at that point?

Pauli: I was wondering why I have to be here because I couldn't catch it all.

Interviewer: You mean you didn't follow the lesson...

Pauli: I would've done but he was going on about coloured wash or something. We didn't get it at all at first. We didn't know what to do.

Interviewer: Jukka, what did you think? Were you following the lesson?

Jukka: I dunno. I was just staring at the empty screen. There was nothing else to do. He's such a boring teacher.

Increased demand for self-regulatory learning may have caused failure experiences for Jukka. Consequently, his ego-defensive orientation has led to avoidance-type coping with plentiful off-task behavior in the course of the lessons. Pauli indicated occasionally a real interest towards the learning task, however, when confronting obstacles he was not prepared to proceed independently, but was willing to help-seeking. His social dependence tendency was dominating, but a conflict between his intrinsic interest and low self-efficacy caused negative emotional self-cognitions. Then ego-defensive coping attempts were awakened which resulted in avoidance behaviour.

Teacher's impulses to *reflection* led on many occasions to reflective and metacognitive thinking among task-oriented students. On some occasions, however, they ignored the teacher's question because of their own high invoivement and individual task-approach, as seen in episode 11. The students also disposed spontaneous reflection. They compared other students' work and were interested in their solutions indicating intrinsic interest.

Episode 11.

Teacher: (Comes up to the boys.) How have you progressed?
Are you trying to get the light flashing? How far have you got?

H & O: (Both mumble and mutter something.)

Teacher: Well, good! You can go on!

Hannu: Yeah, now it actually works! (Both boys look at the model of the washing machine and look satisfied.)

The teacher's reflective questions were usually presented in the beginning of the episode when interacting with the students. Although the questions were helpful to reveal the students' stage of thinking, for some students teacher's impulses towards reflection were experienced as frustrating and ego-defensive coping attempts were aroused as seen in episode 12.

Episode 12.
Teacher: Could you tell me how far have you got?
Pekka: I don't know anymore! What was last thing we tried?
We were trying to get it to wait but it wouldn't do that.
Teacher: Did it just go on?
Pekka: It just didn't work at all. (Sounds nonchalant.)
Teacher: What would you like to have in this programme?
Pekka: Nothing.

Conclusions

This study aimed at exploring the student's situational socioemotional interpretations and task-involvement in learning interaction based on the cognitive apprenticeship model in a technologically rich environment. The data show that the same instructional arrangements were interpreted differently and led to different situational interpretations among the students. The contextual factors, such as the challenging learning task, self-responsible activities and social interaction actualized different motivational coping strategies among the students. The general findings of the present study provide support for an approach that highlights the functional and adaptive roles of cognition and motivation in student learning (Bandura, 1986; Pintrich, 1989; Pintrich and Garcia, 1991; Pintrich, Roeser & DeGroot, 1992; Schunk, 1989). In particular, the results suggest the importance of situation-specific information for understanding socioemotional processes of student learning in classroom environment (e.g. Dweck and Legget, 1988; Pintrich and Strauben, 1992).

The cognitive apprenticeship-based learning made task-oriented students even more task-oriented. The growing task-orientation positively affected the quality of cognitive and metacognitive strategies (Meece, Blumenfeld & Hoyle, 1988; Pintrich, 1989; Pintrich & Schrauben, 1992). The essential methods of the cognitive apprenticeship model, scaffolding, modelling and reflection worked very well between the teacher and task-oriented students. They reached reciprocal interpretations with the teacher, which increased their task involvement and self-directness. Consequently, it can be supposed that to be able to optimally benefit of cognitive apprenticeship methods, a student is assumed to have task-orientation tendency (Vauras, Salonen & Naskali, 1992).

Non-task oriented students were sensitive to the situational interpretations in social interaction. Negative self-cognitions aroused ego-defensive or social-dependence type coping strategies among some students and resulted a lower level of cognitive engagement (Meece, Blumenfeld & Hoyle, 1988). The teacher's scaffolding discussions strenghtened the students' self-efficacy beliefs (Schunk 1989), but did not increase self-directness during the fading phase. Rather, the students became more dependent on social support. Increased demand for self-responsible work, such as modelling and reflection situations, aroused ego-defensive coping attemps among some students and led withdrawal or off-task-work (Olkinuora & Salonen, 1992).

In situated cognition paradigm some promising aspects on students motivation are offered. Authentic learning tasks and learning as an apprenticeship is seen as increasing students' involvement and convince students of the meaningfulness and importance of their learning practices. However, as evidenced in the present study, application of the new learning metaphores does not necessarily automaticly lead to the development of high involvement and intrinsic interest among students, but students' earlier learning experiences may be dominating in new learning environments (Lehtinen et al., 1993). The present study did not use any background information of the students motivational orientation in traditional classroom, but we may suppose that such strong motivational tendencies observed in the study were not only result of the new learning environment, but have been developed in the course of the students' previous learning histories (Olkinuora & Salonen, 1992). However, it seems to be important to find out connections on students' motivational orientation and the special learning environment in this study.

The data show that the cognitive apprenticeship based learning in a technologically rich learning environment was successful for the students characterizing task-orientation in the situation. Based on the earlier research, it can be explained by the general motivational abilities and higher mental processes typical of task-oriented students (e.g. Boekaerts, 1994; Pintrich, Marx & Boyle, 1993; Schunk, 1991) contributed on students' high task involvement and intrinsic interest in the learning situation. The nature of the learning task, challenging and complex project task, may have facilitated students' learning goal orientation (Blumenfeld et al., 1991). Moreover, the control technology used in the project was experienced as a vehicle exploring the complex abstract phenomenon, not an object of an interest itself (Reusser 1992). The basic organizational principles of learning interaction based on the cognitive apprenticeship may have supported students' self-directness. Allowing much choice and self-responsibility as well as decreasing teacher dominance were positively experienced by the task-oriented students (Ames, 1992; Blumenfeld, 1992; Meece, 1991). The social interaction in learning situation was reciprocally experienced as a joint goal-oriented intrinsic interest between the teacher and a student, but its' motivational consequeces may have been small, because of students' strong individual heuristic task-approach (See Järvelä, 1994).

Among the non-task-oriented students cognitive apprentiship based learning caused contradictory effects. Cognitive apprenticeship methods may have been demanding for them. Modelling presumes higher order mental activity, where students' own active cognitive accommondating is presumed (cf. Aebli, 1983; Bandura, 1969), whereas in reflection process selfresponsible working is needed. Low sense of self-efficacy and insufficient cognitive processes typical for non-task oriented students (Pintrich & Garcia, 1991; Pintrich & Strauben, 1992) may cause feelings of insecurity and negative self-conceptions, which, in turn, may arouse ego-defensive or social defensive type coping attemps, as was evidenced in the present study. Moreover, if a student is directed to external control (Harter, 1981), socially structured teaching method (cf. Vygotsky, 1978), scaffolding, for example, may increase teacher dependence as was found also in this study.

On the other hand, the data show that the technologically rich learning environment based on the cognitive apprenticeship may enhance non-task-oriented students' self-efficacy beliefs. Learning as socially shared activity involves emotionally supportive learning context. For example, the teacher modelled for the students coping with difficult situations as well as positive emotional experiences in problem solving (Vauras, Lehtinen, Olkinuora & Salonen, 1993). The teacher's positive performance feedback and observing similar peers may have provided students with self-efficacy information (Schunk, 1989). The complex learning task has obviously been difficult to get involved in for the non-task-oriented students. However, with the help of the modern technology, the complex abstract phenomenon was able to be simulated and concretisized, which may have increased students' understanding and similarly produced positive learning experiences.

To conclude, the new constructivistic learning environments presuppose different, more dynamic task-approach for student than learning tasks in a traditional classroom. Different motivational and strategic abilities are obviously needed. The present study points out, that the meaningful, complex learning task in a technologically rich learning environment and cognitive apprenticeship learning created self-motivating, dynamic learning process for task-oriented students. More research is needed to explore whether this type of learning environment can foster task-oriented learning among all students in a long run.

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