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Small Groups Learning Synchronously Online at the Workplace: The Interaction of Factors Determining Outcome and Acceptance

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Abstract: E-learning at the workplace might be accomplished by synchronous cooperative learning sessions of small groups using net-based communication. This form of learning is suitable both for course-based e-learning as well as for knowledge transfer within the company. The small groups learn self-regulated, i.e. without the guidance of an instructor. However, the learning tasks are pre-defined and a specific learning process is precisely described. In the present study, the goal of the cooperative learning sessions is to deepen pre-existing declarative knowledge. During cooperative learning, group members are required to actively use, acquire, enrich and exchange their knowledge. In a field study carried out in a large software company, a software tool was used which supported the specific process by phase-specific delivering of instructions and learning materials as well as by means of process control (including turn-taking, role assignment, and coordination of task flow). The results of the empirical evaluation demonstrate a high amount of topic-oriented contributions and the realization of the expected learning activities. However, feedback data indicated a low acceptance of the software tool because of its restrictive process control. It is discussed that there might have been a non-optimal interaction between the factors technology and target group in the study.

Keywords: Professional Training, Workplace Learning, Computer-Supported Cooperative Learning, Quality Assurance, Empirical Study
Categories: J.4, H.1.2, H.5.1, H.5.2, H.5.3

1 Introduction

1.1 Learning at the Workplace

Professional training might well be enhanced by computer-supported cooperative learning (CSCL) using the communication and information technologies that are already present at the workplace. The same is true for the knowledge transfer within the company. For instance, e-conferencing tools might be used for (a) highly interactive virtual classroom training of small groups with an instructor (as part of an e-learning course), (b) highly interactive e-meetings of small groups with a content expert of the company (knowledge transfer), (c) live streams of online talks and presentations which are sent to a large number of employees (knowledge transfer), or (d) recordings that are made by content experts of the company and that are hosted in an e-learning library in which the recorded units can be found company-wide (knowledge management). However, the highly interactive forms of cooperative learning remain cost-intensive and slow since only a small number of participants can be trained by one instructor at a time.

In the present study, an attempt was made to introduce cooperative synchronous online-learning in small groups at the real workplace. The learning was self-regulated in the sense that there was no instructor or content expert present in the online sessions. However, there was a well-defined learning process specifically supported by a software tool, and there were tasks for the groups developed by an e-learning author. The process support and the tasks served the purpose of achieving predictable learning processes of the groups.

At a first glance, those task / process restrictions stand in contrast to the principle of "self-regulation". However, we think that for many learning situations in professional training it is desirable to have some control (i.e. predictability) over learning processes and the to-be-expected learning outcomes. This is particularly true if the to-be-acquired knowledge is well defined, which is quite likely in professional training. Without a precise description of an online learning process for a group in professional training, processes tend to be unpredictable and sub-optimal ([Linder, 03], [Münzer, 03]). Furthermore, an online instructor fulfills two roles, the role of a teacher and the role of a moderator who coordinates the learning process, controls the turn-taking, provides the learning materials, etc. While process support of a software tool might help with respect to the coordination of the process, the members of a small group are quite free regarding their response to the instructions (i.e. the execution of the intended learning activities like asking and explaining, the fulfillment of roles assigned to them, etc.). Finally, the matter of self-regulation also concerns cooperative behavior among the members of a group based on attitudes and experiences (e.g. the attitude to help another employee rather than to feel wasting time). Thus, even if predictability of the process is intended, there is much beyond coordination support that relies on the responsiblity of the participants.

Predictable learning processes include predictable learning activities of the individual group members. Furthermore, predictability should secure that the learning tasks provided are actually processed. The method described in the present paper is best suited for situations in which the to-be-learned knowledge already exists in a well-defined form (e.g. learning how a new software works, learning about new features of a company´s product, achieving a deeper understanding of a new workflow), in contrast to situations in which a group generates new knowledge (like in a problem solving process) or transform knowledge (like the transformation of procedural into declarative knowledge for purposes of documentation). Participants are asked to clarify questions and to elaborate on the knowledge depending on their prior knowledge and the practical problems they have to solve at their workplaces. Thereby they learn actively, help each other, and apply the knowledge. Thus, in the present context learning in small groups has the goal to enrich and to support individual learning rather than to achieve shared knowledge among group members.

If small groups learn self-regulated and cooperatively in a predictable way, then both e-learning and knowledge transfer in a company can be rapid, reliable and cost-effective. The method is specifically suitable if a large number of participants have to be trained in a short period of time, since those groups can learn in parallel once an author or content expert has provided learning materials or documents. However, it has to be shown that (1) the intended process in combination with the tool support actually allows effective learning at the real workplace and (2) is accepted by the participants in professional training. In the present paper, the following factors, and their interactions, are described based on an evaluation of the learning processes and on the feedback data collected from the participants:

- Learning Context
- Instructional Design
- Technology
- Tasks
- Target Group

We will focus on the specific learning method that is, from our point of view, appropriate for the cooperative deepening of declarative, pre-defined knowledge. In the present paper, we describe both the instructional design and the software tool as well as experiences made during a field study in a large software company in which employees learned cooperatively at their workplaces.

1.2 Cooperative Learning

There are a number of methods for self-regulated cooperative learning that address the goal of understanding, rehearsing, and deepening of knowledge. For instance, the term "peer teaching" refers to methods in which participants take over the roles of teacher and learner and perform learning activities such as asking certain types of questions and delivering explanations (e.g. [King, 97]). The term "cooperation script" also describes a well-defined chain of learning activities in which, for instance, student dyads summarize, rehearse and elaborate on contents read from text (e.g. [O´Donnell, 92]). Explaining to others is a central learning activity that improves the understanding particularly of the explainer ([Spurlin, 84]).

Recently, such methods are introduced into the field of online-learning. The methods are specifically supported by software tools using text-based communication or video-conferencing (e.g., [Hron, 97], [Pfister, 02], [Pfister, 03]). For instance, a "learning protocol" as executed by a specific software ([Pfister, 03]) enforced participants to relate a message to a former message, to select a pre-defined message type, to follow a fixed order of turn-taking, and to act according to a role description that is automatically assigned to a participant. However, these studies were carried out in the laboratory, not in the real learning context of professional training.

Virtual classroom / e-meeting tools are currently the standard for highly interactive, synchronous cooperative distance learning. They are designed both for e-conferencing and for classroom distance learning, i.e. for a kind of learning in which an instructor teaches a group of students. Such tools comprise of an auditory communication channel, functionality to control the turn-taking, and a whiteboard with referencing functionality. However, those tools are instructor / moderator-centered. Since many functionalities are controlled solely by the instructor, including the learning materials on the whiteboard, the administration of a learning session, and the floor control, virtual classroom tools might not be appropriate for self-regulated, cooperative learning of small groups. Furthermore, those tools do not support the coordination of specific learning processes.

Synchronous text communication might be an alternative to e-conferencing. Text-based communication (e.g. instant messaging, chat) is already widely used on a self-regulated basis and becomes recently recognized as a valuable workplace communication medium ([Herbsleb, 02], [Muller, 03], [O´Neill, 03], [Gergle, 04]). The proposal that chat is not a "rich" medium ([Daft, 86]) might not be a problem for cooperative learning or for workplace communication. However, some of the media characteristics ([Dennis, 99]) of conventional chat tools, particularly the parallelism, speak against it as the communication medium for focussed and topic-oriented communication as it is required in cooperative learning. For instance, chat conversations often tend to be confusing. This is mainly caused by non-observable and parallel message preparation. Studies exploring cooperative learning in professional training using standard chat tools demonstrated sub-optimal learning processes which were hard to predict ([Linder, 03], [Münzer, 03]).

We propose that the decisive factor for successful learning is an appropriate process support that is implemented in a communication tool for cooperative learning. Currently, neither e-conference tools nor text-based communication tools support learning processes for self-regulated learning of small groups. In contrast, the tool developed in the context of the present study has specific process control capabilities (see below).

1.3 Learning Context, Culture and Target Group

The present study was conducted in the German software company SAP AG (Walldorf, Germany) which operates internationally and disposes of more than 30.000 employees. About 80 % of the employees at SAP hold an academic degree. Employees are quite free regarding the organization of their work. They use computer-mediated communication regularly. The training and transfer unit SAP University organizes the formal training in the qualification program for the employees, as well as the internal knowledge management and the customer training. Partly, the company-specific knowledge management is realized by the employees themselves, i.e. employees produce e-learning units for their colleagues. The e-learning library mirrors the rapid knowledge change in the company, and the e-learning units are widely used by the employees on a self-regulated basis. Besides this, there exist other forms of e-learning for fast knowledge transfer, for instance video-conferencing with an expert for groups of about 10 to 30 employees.

Thus, there is a highly developed culture for self-regulated working and learning in the company. Employees are used to learning at their workplaces, searching for information and acquiring knowledge when needed. However, self-regulated cooperative learning of small groups has rarely been realized as yet.

1.4 Instructional Design for Cooperative E-Learning

In a situation in which neither teacher nor moderator is present, the moderator role for the organization of the learning process and the teacher / learner roles have to be taken over by the members of a small group themselves. Whereas the coordination of a learning process can be supported by software (and partly be automated, see below), the participants are required to act according to their roles, to exchange their knowledge, to help each other, etc. This means that participants have higher responsibility for the learning outcome than it is the case in traditional, instructor-centered teaching. However, a well-defined instructional design (precisely describing who should do what and when and with which materials) should help the participants to interact successfully. The instructional design should address both the activities of the participants as well as the coordination of the process.

The instructional design of the cooperative learning episode to be reported here aimed at a clear and fine-grained description of the process. The instructional design comprises, at some higher level of description, the central learning activities that should be executed by the participants, the different roles for participants which allow them to interact during learning, and the phases that are characterized by intermediate goals during the learning process. At some lower level of description, detailed problems of coordination are solved (e.g. delivering the materials and instructions, assignment of roles, task-flow, etc.). The lower level of description is of particular importance if learning takes place in an online communication medium.

The goal of the cooperative learning sessions was to deepen the conceptual and verbalizable procedural (how-to-do) knowledge about a software program. In general, participants learned by explaining to each other how the software works, and what can be done to solve little problems they were presented with. Participants explained, asked each other and elaborated mainly in relation to screenshots of the to-be-learned software which were provided in the learning materials or which could be made and uploaded during the sessions by the participants themselves. Cooperative distance learning was used to accomplish an introductory web-based software training (for a description of the procedure, see below). The cooperative learning session consisted of a number of well-defined tasks that were related to the contents of the web-based course. The instructional design describes a series of learning activities that apply for every task. Firstly, one of the participants was assigned the role of an “explainer“. The “explainer“ told the other group members about concepts and features of the software following a role-specific instruction. He/she related his/her explanations to the learning materials designed for this task or publish his/her own learning materials. Secondly, there was a “commenting” phase. When the “explainer“ had finished his/her contributions, then all group members could comment on the given explanation, they could ask questions to the other group members, they could elaborate on the knowledge in question, and they could publish additional learning materials. A second instruction prompted those activities.

1.5 Support for Cooperative Learning by a Software Tool

The cooperative learning processes were realized using the software tool Bubble-chat which was specifically developed for the present study. A screenshot of the tool is depicted in Figure 1.

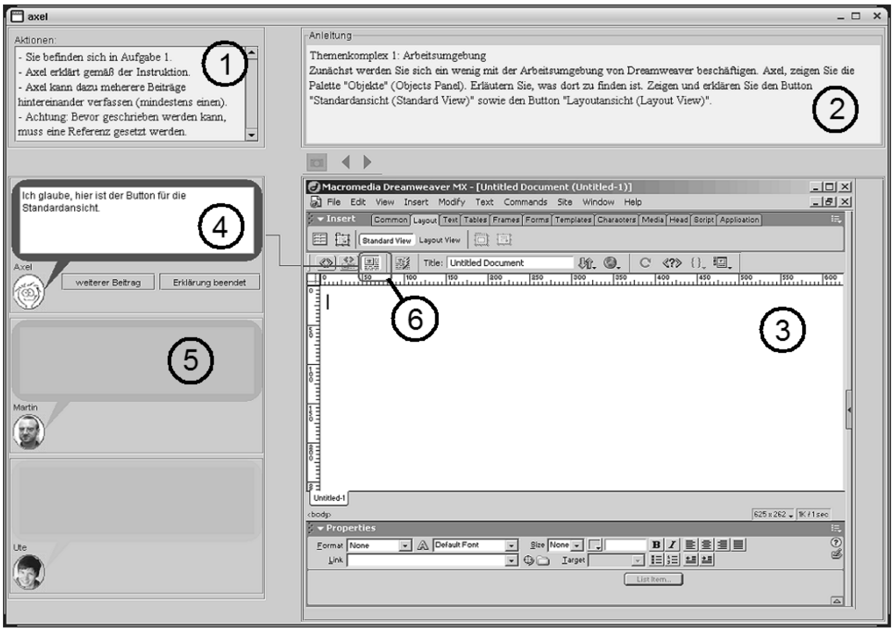

Figure 1: The Bubble-chat tool as used in the study. (1) Status area displaying process information (e.g. task number, active participant, role of the participant), (2) instruction area, (3) learning materials area (displaying a screenshot of the to-be-learned software), (4) active bubble, (5) inactive bubble, (6) referencing feature.

The software tool provides support for cooperative learning on several levels.

1.5.1 Providing Text-Based Communication With Observable Writing

The software tool is called Bubble-chat because of its characteristic realization of text-based communication. Every participant owns his/her own bubble, which is located at a fixed position in the graphical user interface of Bubble-chat (see Fig. 1). When a participant prepares a message, his/her typing appears (in a letter-by-letter fashion) in his/her bubble at the graphical user interface at every participant. Therefore, the writing activity of a participant is observed real-time by all other participants. Bubble-chat is different from conventional chat tools since messages are not edited before sending, and there is no message list. However, participants can switch back and forth the former messages of the other participants.

1.5.2 Providing Instructions and Learning Materials

There are separate areas in the graphical user interface that show instructions and learning materials (see Fig. 1). Participants may add own learning materials by using the snap-shot feature. The snap-shot feature enables participants to make a screenshot from a region of their individual desktop (the Bubble-chat tool window is taken away from the desktop when the function is activated) and publish it in the learning materials window. Participants may switch back and forth the materials while the instruction is preserved.

1.5.3 Providing the Relation Between Materials and Communication Messages

The referencing feature (see Fig. 1) allows for pointing at specific areas on the learning material, thereby establishing the relation between the contribution and the materials. The references are preserved and appear again when a session is re-played in the Bubble-chat player tool or when participants switch back to a former message or to another learning material.

1.5.4 Providing Process Control

The tool provides support both for the flow of tasks and for the flow of the learning phases within tasks according to the instructional design described above. More specifically, there is process control on three levels. Firstly, on the lowest level, turn-taking is controlled. Only one participant may be “active“ at a time and therefore able to write. Secondly, on an intermediate level, there is a phase control within a task (explanation phase vs. clarification / elaboration phase). In the first phase of each task, the tool selects a participant for the "explainer" role automatically. This participant then is "active" and therefore able to write. Thirdly, on the highest level, the tool coordinates the flow of the tasks. Participants may suggest going to the next task by clicking a button in the second phase. The other participants are then automatically asked for agreement. If all agree, then the tool switches to the next task. In combination with the task flow coordination, instructions and learning materials are presented task-wise.

1.5.5 Providing Awareness

Awareness of the learning process is provided in an extra area in the graphical user interface showing the task number, the phase number, and the name of the participant who currently holds the explainer role. In addition, awareness about the floor control is provided by the coloring of the frame and the text field of the bubbles, indicating the active participant (see Fig. 1).

The process support and process control capabilities of the software tool Bubble-chat are intended to make the learning process clear and predictable, to reduce coordinative efforts, and to avoid confusion during text-based communication. For instance, the observability of writing provided by the bubble view and the floor control mechanism both guarantee that the focus of attention is always on the participant who contributes a message. The referencing functionality avoids ambiguities and complicated reference descriptions. The automated role assignment and the automated coordination of task-flow both reduce coordination efforts.

2 Empirical Study

2.1 Overview

We will briefly describe the method and the evaluation results of an empirical field study carried out at SAP. For the purpose of the present paper, we will focus on the feedback data collected from the participants and the implications for the quality of cooperative online learning at the workplace.

2.2 Participants, Materials, and Procedure

The web-based software training was open for registered users at SAP during a limited time of about four weeks. Six groups of two or three members each completed the cooperative learning session 1 using Bubble-chat in addition to the web-based training. Another three groups also began with the learning session 1, but stopped learning before reaching the end of the session, or used other communication channels in addition (i.e. telephone conference).

The web-based training offered an introduction into the web design software "Dreamweaver MX" (by Macromedia). The introductory web-based training was developed in a department of the software company itself (SAP Corporate Research) and it was delivered to the participants via the e-learning platform SAP Learning Solution. The cooperative learning episodes were realized separately using the DyCE (Dynamic Collaboration Environment; [Tietze, 01]) groupware platform provided by the software company go4teams GmbH (Darmstadt, Germany). The Bubble-chat tool was developed by Fraunhofer IPSI. The web-based training consisted of two modules with about 1 hour training time each. There were two corresponding cooperative episodes. The cooperative learning session 2 focused on the application of procedural knowledge and therefore followed a slightly different instructional design. The present paper reports results obtained from the cooperative learning session 1.

Participants were provided with technical and organizational support concerning the installation and functioning of the Bubble-chat software and the meeting dates. Participants attended the virtual sessions after individual learning with the web-based training. Before the cooperative learning session 1 started, the groups completed a cooperative training session in which the learning process was explained and in which they learned to use the software tool Bubble-chat. This training session consisted of three tasks in the Bubble-chat tool and lasted about 15 min. After completion of the learning session 1, an online feedback questionnaire opened in the participants´ browsers that had to be answered individually. All participants learned at their normal work places during their work time.

2.3 Evaluation of the Cooperative Learning Process

2.3.1 Content Analysis

In order to evaluate the quality of the learning process, a content analysis of the chat contributions of the six groups was performed. The categories for the coding of the chat messages were derived from the instructional design, i.e. from the intended learning activities that were prompted by the instructions. The most important coding categories therefore were *explanations*, *clarifications* (questions, answers), and *elaborations* (relating new information to prior knowledge, discussing aspects beyond the given instruction). Contributions falling in those categories represented the expected learning activities. Meta-comments concerning the view of a problem (e.g. agreement to a problem description, indicating understanding and a shared view) were counted as *grounding* messages. Besides this, there were messages for the purpose of coordinating the learning process of the group (*coordinative messages)*. In addition, there was a category for *comments* concerning the functioning of the Bubble-chat tool or the learning situation in general. Finally, *social messages* (jokes, etc.) were sorted into an own category.

The results of the content analysis of the contributions in the cooperative learning session 1 can be summarized as follows.

- The group discourses were highly topic-oriented. On the average, 77 % of the messages in a group were topic-oriented.
- The learning activities *explanations* and *clarifications* dominated the learning discourses. On the average, 37 % of all messages were *explanations,* and 19 % of the messages were *clarifications.* Contrary to the expectations, only 5 % of the messages were *elaborations*. Group members expressed their shared views on a problem quite frequently (16 % *grounding* messages on the average).
- On the average, only 8 % of the messages were written for the purpose of *coordinating* the learning process of the group.
- Both the number of *comments* as well as the number of *social messages* were in the range of the number of coordinative messages.

2.3.2 Task Completion

In each of the tasks, there was an instruction for the explanation phase and a general instruction for the second commenting phase. Furthermore, in 7 out of 8 tasks there was another hint given for further elaboration. Thus, in the 8 different tasks, there was a total of 23 different instructional elements given to the participants. Two raters evaluated the quality of task completion according to the instructional elements. On the average, 18 out of 23 sub-tasks (78 %) were actually processed, and, on the average, 5 out of the 23 sub-tasks were not completely performed while only 3 out of the 23 tasks were deepenly worked through (i.e. there was elaboration, including discussing about aspects not covered by the instruction).

2.3.3 Participants’ Feedback

The feedback data obtained from the online questionnaires show a mixed evaluation of the Bubble-chat tool as well as of the learning process from the participants´ point of view. Only a minority of the participants agreed with the statement that the software tool had been easy to use. Participants commented additionally that the behavior of the tool had been somehow slow and complicated, and that the turn-taking mechanism had been too restrictive. Several participants recommended using the auditory modality as the main communication channel. Most participants evaluated some of the tasks as appropriate, but some others as not appropriate. Similarly, the learning processes of their respective groups were evaluated as only partly successful by most of the participants. Only half of the participants got the impression of successful learning, but the others expressed some doubt about their personal learning success. Many participants were of the opinion that the learning process as such had been too restrictive. Some participants wrote additionally that the prior knowledge differed between group members. Some participants had missed a tutor or an expert for clarifying open questions during the learning sessions. For the organization of their learning times, participants found the virtual learning sessions helpful, forcing them to actually learn within the given time of about four weeks. Some participants evaluated features and usability of the Bubble-chat tool from a software developer´s perspective in their comments.

3 Discussion

3.1 Factors Determining the Quality of Cooperative Learning and Their Interaction

In the present study, synchronous cooperative learning episodes at the workplace were realized in the work context of a large software company. Small groups of two or three participants each deepened their knowledge about how to use a specific software in virtual cooperative learning sessions. The factors influencing the quality of learning which are considered most important here are (1) the context, (2) the instructional design, (3) the technology, (4) the tasks and (5) the target group. These factors, and some of their interactions, will now be discussed (see Fig. 2).

3.1.1 Learning Context

The necessary prerequisites of e-learning were present in the learning context of the software company. Employees dispose of the net-based communication means, they are able to organize their work and their learning by themselves, and there is a widely accepted e-learning culture which serves partly as the knowledge management of the company. However, at the time of the study, synchronous cooperative distance learning was not widely realized.

3.1.2 Instructional Design

The instructional design aimed at predictable learning processes of the small groups. The intended learning activities, i.e. *explanation, clarification,* and *elaboration,* were explicitly prompted in a structured way. In general, results show that the learning discourses of the groups were highly predictable and topic-oriented. The instructional design as realized in the present study was particularly successful in eliciting explanations as well as clarifications, but it was less successful in eliciting elaborations.

3.1.3 Technology

The instructional design was implemented in a software tool which controlled the process on several levels, thereby maximizing the predictability of the learning process and reducing the coordinative effort of the group members.

- *General effect of process control for coordination.* Since the content analysis demonstrated a very small number of coordinative messages, it is concluded that the process control implemented in the tool worked successfully, at least for the purpose of reducing coordinative efforts. During the learning process, there seemed to be little need for coordination or moderation when communicating with Bubble-chat.
- *Task selection and shared focus.* Since the process control comprises a task flow, tasks are successively selected and presented by the software as they are prepared by the author of the cooperative learning session. Coordination for a task shift is automated. There is no freedom to select tasks and leave tasks out. This might guarantee some engagement and work on all of the tasks. Furthermore, an automated task flow with instructions and materials that cannot be selected by participants individually guarantees a shared focus among the group members. A shared focus is reflected in the results of the content analysis both by the amount of clarifications as well as by a considerable amount of grounding messages. Finally, agreement of all participants was required for moving on to the next task. There was no possibility for a single participant to direct the attention of the group, or to dominate the process. This had the effect that coordinative messages contained polite questions for agreement, in accordance with the tool functionality.
- *Roles and phases.* Another factor that might have contributed to predictable learning activities is the process control for the instructional design within a task, which was realized mainly by an automated role assignment for the "explainer" and the subdivision of a task into two separate phases ("explaining" and "commenting" phase). It might be assumed that automated role assignment reduced coordinative efforts (i.e. coordinating who will begin with an explanation). However, it is not clear as yet whether the implemented process control on this level actually contributed to the predictability of learning since controlling roles and phases interacts both with the actual tasks (instructing what has to be explained and clarified) and the target group (being experienced with self-regulation). For instance, the finding that explanations and clarifications, but not elaborations were successfully elicited presumably results from an interaction of task and instructional design. The feedback of the participants that the process control was too restrictive presumably results from an interaction between target group and implemented process control.
- *Turn-taking.* The implemented control on turn-taking generally received low acceptance by the participants.

3.1.4 Tasks

As the results demonstrate, some of the tasks were not completely performed, and the number of deepenly performed tasks was rather small (corresponding to the small number of elaboration messages found in the content analysis). This finding may relate to the feedback given by the participants that not all of the tasks seemed to be appropriate. However, it is difficult to draw conclusions about the quality of the tasks, since different groups preferred different tasks. Depending on prior knowledge, as well as on individual experiences with the to-be-learned software, the groups might have decided which tasks were easy, which were difficult, and which were worth the investment of deep and complete work. However, there was no conscious and explicit decision process concerning the selection of important tasks in the groups.

3.1.5 Target Group

The employees of the software company dispose of highly developed self-regulatory abilities. This is also reflected by the work conditions provided in the context (see above). The topic-orientation that was observed in this study may rely mainly on attributes of the target group, too. The detailed comments concerning features of the Bubble-chat tool given by the participants may reflect their expertise as employees of a software company.

3.1.6 Interaction of Instructional Design and Technology

The instructional design is quite specifically reflected in the process control capabilities of the Bubble-chat tool. Results indicate that such a fine-grained and specific fit between instructional design and technology lead to predictable cooperative learning processes. The tool successfully controlled the process, coordinative effort was reduced, and most of the intended learning activities were found in the content analysis.

3.1.7 Interaction of Instructional Design / Technology and Target Group

Participants´ feedback indicates that the process control was too restrictive for them. Thus, there might be some non-optimal interaction between instructional design / technology on the one hand and the target group on the other hand. The self-regulated working at the software company seems not to be reflected in the instructional design and the process for group learning. However, to work successfully on a self-regulated basis does not necessarily mean to learn successfully in a self-regulated small group. The conclusion of a prior study on cooperative distance learning conducted in the same context ([Münzer, 03]) was that there was an explicit process missing, resulting in unpredictable outcomes. Therefore, a way has to be found to reach some predictability of group learning and especially to support coordination but not to make participants feel uncomfortable because of a too restrictive control of the process. In particular, the process control functions that provide a coordinated task flow and a shared focus (highest level) should be preserved while there should be no control over the flow of communication (turn-taking, lowest level). For the specific target group addressed here, the process control over role assignment and learning phases (intermediate level) might not be necessary. Nevertheless, for participants who are less experienced in self-regulated working and learning this level of process control might be helpful.

3.1.8 Tasks and Target Group

There was an interaction between the tasks and some preferences for the selection of tasks by groups or individual participants. Tasks were treated differently by different groups, and prior knowledge was not the same for all participants. This was surprising since the web-based training was announced for beginners. The tasks were thought to be most effective for participants with homogeneous prior knowledge.

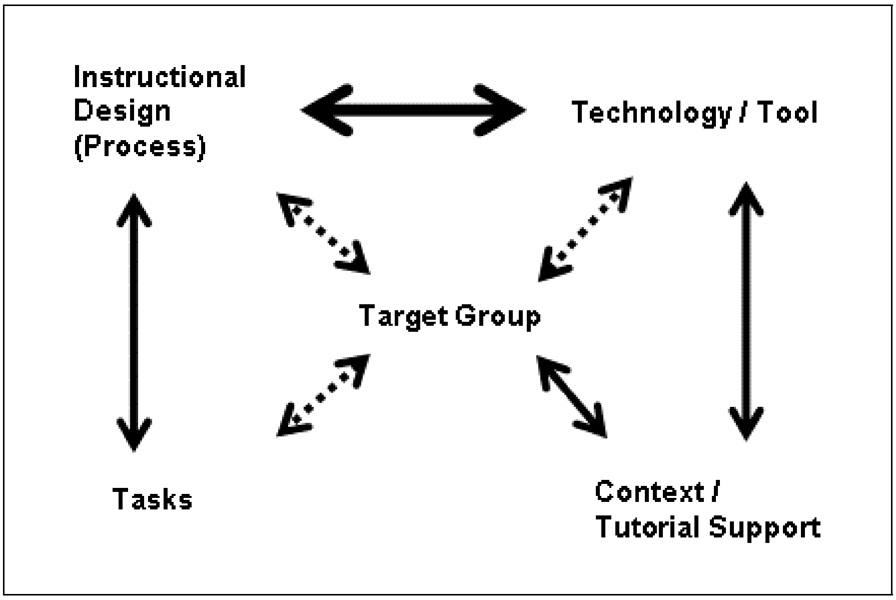

Figure 2: Factors determining the quality of the cooperative learning process and their interactions as found in the study. Dotted lines indicate non-optimal interactions.

3.2 Recommendations for Redesign

Some recommendations for the redesign of the learning process as well as of the software tool can be given on the basis of the present evaluation.

- A list of the tasks (with brief descriptions) could be provided. Before a group starts working on the first task, the participants may inspect the list and judge the relevance and the level of difficulty of the tasks. Then the group members decide on the priority of the tasks. Different views on tasks and problems (and thereby different prior knowledge among group members) would be detected during this explicit selection process. Furthermore, participants may add own questions to the list. However, these suggestions may mean that some tasks will be left out because participants might just have the illusion of already knowing. As a consequence, possible questions would remain undetected.
- There might be some changes in tool features to decrease the control over the process. For instance, instead of a fixed turn-taking procedure, a „hand-raise“-feature might be more appropriate for solving the turn-taking problem. Another possibility is to open all the bubbles for parallel writing. Independent of sorting the task list according to the participants´ priorities, as recommended above, the tool should coordinate the task flow.

- Solutions to all tasks might be provided after the learning session, and content experts might be asked for answers to all the questions that could not be clarified by the participants themselves. Those questions could be collected in a separate list during the session, and that list could automatically be sent to an expert after the session via e-mail. Additionally, tutors may inspect the group learning off-line for evaluation and feedback purposes. Another possibility is that a tutor or content expert, who is virtually available on the internet, may visit a group who asks for help. However, it is not necessary to have a tutor in the actual session who manages the learning process and instructs the participants for specific learning activities.
- Although many participants recommended the auditory modality as the main communication channel, it is recommended to use text-based communication because it can easily be stored, inspected and evaluated, and feedback can be given off-line.

In addition to improvements regarding the learning process and the tool, the target group might learn (or might be trained) about group learning processes. A process control which is realized by software might be understood as support, not as restrictive control, if the instructional design for group learning is clearly stated and accepted by the participants. Another problem concerns different prior knowledge in a group. In the present case, homogenous groups seem desirable. Alternatively, participants who have prior knowledge in a group might help their colleagues, taking the role of an expert or teacher with the motivation of transferring knowledge within the company (instead of feeling wasting time).

4 Conclusions

In professional training, often the explicit acquisition of knowledge and skill is the goal of learning. This is true both for course-based e-learning as well as for the knowledge transfer within the company. The present study demonstrated that this kind of explicit learning might well be enhanced by synchronous CSCL using communication technologies. Cooperative learning might especially help to transfer the knowledge which had been acquired individually in a web-based training to the specific needs of the company, i.e. to the specific work flows and communication processes, and to the specific roles of the employees. For instance, company-specific work processes using a new software might be trained in virtual learning sessions as described in the present study, while a standard web-based training can be used for the acquisition of basic knowledge. Similarly, cooperative learning can help to achieve a deeper understanding when transferring knowledge in the company, for instance, when members of the sales department discuss features of a new product and apply the sales strategy to their individual situations and customers. In addition, cooperative learning at the workplace may have a number of positive side effects. Colleagues learn from each other and exchange opinions, they do not feel alone while learning, they build up formal and informal contacts, and they synchronize their learning times. Those side effects are most likely to occur when cooperative learning is synchronous and when the groups are small.

Using synchronous CSCL with a clearly stated learning process which is controlled by a specific software tool makes the learning processes of groups predictable and decreases the coordinative efforts during the session. Although participants asked for an expert to clarify some questions during the learning session, the tool successfully managed the learning process. Thus, a tutor as a "learning process manager", or "instructor", is not needed in such a learning session. This might reduce costs for cooperative learning dramatically. Content questions might be additionally answered off-line by an expert, and questions and answers can be published in a forum.

We see a wide range of applications for the learning process support as provided by the Bubble-chat tool. The process presupposes that the learning goal is to deepen some pre-defined, conceptual, declarative knowledge, as it is often the case in professional training. In the context of knowledge management, Bubble-chat might also be used informally by groups of employees who feel the need for clarifying open questions, e.g. about a new product. However, the tool might be less useful for generating ideas, for the development of new knowledge, for information exchange or for decision-making, or for practicing skill.

The present study shows a complex interaction of factors determining the quality of cooperative online learning at the workplace. Both effect (a predictable learning outcome) and acceptance have to be taken into account. In particular, some attributes of the target group (e.g. self-regulatory abilities, prior knowledge, preparation for and attitudes towards group learning) might conflict with the control over the process that is executed by the software tool.

Further studies are needed to find out more about an optimal fit between instructional design, task, technology, context, and target group. These studies should be carried out as field studies, as the present study.

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