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Learning Groups

The Role of Learning Processes in Evolutionary Implementation of Groupware

Klaas Sikkel
Marike Hettinga
Tatyana Bondarouk
Jan Gerrit Schuurman
(Eds.)

University of Twente
The Netherlands

Telematica
Instituut

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More information and an electronic version of this report are available from the workshop website

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Editors' addresses

Klaas Sikkel
University of Twente
Faculty of Computer Science
PO Box 217
7500 AE Enschede
The Netherlands
sikkel@cs.utwente.nl

Marike Hettinga
Telematica Instituut
PO Box 589
7500 AN Enschede
The Netherlands
marike.hettinga@telin.nl

Tatyana Bondarouk
University of Twente
Faculty of Technology & Management
PO Box 217
7500 AE Enschede
The Netherlands
t.bondarouk@sms.utwente.nl

Jan Gerrit Schuurman
Telematica Instituut
PO Box 589
7500 AN Enschede
The Netherlands
jangerrit.schuurman@telin.nl

Preface

How does group learning, in particular *reflective restructuring,* affect the implementation of groupware in organisations? Which factors determine whether reflective restructuring takes place – and to what effect? These questions sparked off the idea to organise a workshop around the role of learning processes in evolutionary implementation of groupware.

The workshop *Learning Groups* took place at 16 September 2001 at the occasion of the 7th ECSCW conference. In a way, it is the successor to a *workshop Evolving use of Groupware* that was held at the 6th ECSCW conference, in which two of the organisers and three other participants took part. From this workshop we maintained the general concept to let participants work in small discussion groups. This proved to be a good thing to do, as all participants, including the organisers, seemed to be quite happy with the result. So at this place we do acknowledge the ground work of Erik Andriessen, Elske Heeren, Marike Hettinga and Volker Wulf who organized the 1999 event.

The workshop *Learning Groups* combined elements of explanatory and exploratory study. The purpose was to analyse concrete case histories from a learning perspective and to improve discussed theoretical concepts. Do the theoretical concepts apply to the cases, and does this give us clues as to how to improve reflective restructuring with teams? Secondly, we wanted to raise awareness about the relevance of the workshop theme. Hence it is worthwhile to compile a report with the inputs (position papers and presentations) and outputs (small group reports and conclusions).

Another purpose, obviously, was to have an event that was pleasant and useful for the participants. To make it "a day of learning," as the call for participation claimed, the focus was on small working groups which had been given a clear task: to apply one of several learning theoretical concepts to a given case history. For each case history, an involved resource person was present to answer any question beyond the written case descriptions. This proved to work really well and one of the things we have learnt is that – with a good group of participants, of course – this is powerful concept for a workshop.

Thanks Alejandro, Anabela, Anders, Dulce, Gerry, Helge, Ilona, Ingrid, João, Oliver, Tony and Uta for being constructive participants and for making the workshop a success.

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Klaas Sikkel
Marike Hettinga
Tanya Bondarouk
Jan Gerrit Schuurman

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Introduction

Evolutionary implementation of groupware is an issue that attracts a growing interest in the CSCW community. When a groupware system is introduced, it is not readily apparent which is the best way to work. Numerous studies show that it is hard to predict use in practice; user groups apply CSCW technology in unanticipated ways. User groups have to experience how they can use a system to their advantage, how to employ the technology to improve their work practices. This process of appropriation by a group is different from an individual one and can be seen as a *cooperative learning process*. An approach from a learning-oriented perspective can be helpful here, both on a theoretical level – providing us with an explanation of how appropriation of groupware takes place in reality – as on a practical level – providing insights that could help improve the process.

Learning processes of individuals have been on the research agenda ever since the first schools were built. Learning organisations form a more recent and very popular topic of studies and debate. Learning groups, however, fall a little short of attention and deserve more interest.

In a number of case studies in which the workshop organisers participated, there was an initial phase of learning to work with the system, but no *reflective restructuring*. It was felt that a lot more could be gained from the system if the group would make an effort to critically reflect upon its way of cooperative working. But how to obtain this?

We believed that these experiences are not unique, and the same problems exist elsewhere. For this reason we submitted a workshop proposal to the ECSCW conference. A better understanding of the learning processes that take place in groupware implementation could provide us with ideas on how it can be improved.

The workshop was a good example of collaborative work. Based on the position papers, several participants were invited to present a theoretical perspective on learning, others to contribute a case history of groupware implementation. The major task at the workshop, then, was to explore in small groups whether the theoretical perspectives have something relevant to say about the case histories. The underlying idea is that the relevance of such discussions is increased by grounding them in real life experiences.

As a theoretical frame of reference for this workshop we used the terminology of Donald Norman (1993) as described in *Things that make us smart*. He distinguishes three kinds of learning:

– *accretion*: accumulating facts (learning how the system works)

– *tuning*: developing of skills (learning to work with the system)

– *restructuring*: building new conceptual skills through reflection (how to improve work practices)

Learning takes place in two different modes: accretion and tuning are mostly experiential, while restructuring is a reflective process.

The framework was introduced by Norman to describe individual learning, but the same learning types can be applied to an interpersonal group learning process.

Marike Hettinga and Ingrid Mulder both have applied Norman's concepts to group learning. Marike puts an emphasis on interaction types between group members, Ingrid has a focus on concepts, rather than skills, and assumes a fourth learning type ("co-construction of knowledge") applying to group learning.

A model of collaborative knowledge-building, identifying steps in social knowledge building and the interaction with personal understanding, was presented by Gerry Stahl.

Tanya Bondarouk, finally, presented a model of experiential group learning, which includes five interrelated steps of cooperative interactional processes: collective acting, team reflecting, sharing understanding, sharing knowledge, and mutual adjustment.

The following case histories were studied in small groups.

MOISIG (Management, Organisations and Information Systems Interest Group) is a group of Portuguese academic researchers at different locations who want to share and develop their members' skills and knowledge. It has characteristics of a community of practice, and different learning stages could be identified.

The BRIDGE project is a EU project developing a collaborative environment. The development team made a conscious effort to use the environment they were working on by themselves to support collaboration in the distributed team, so as to get a first-hand user experience in order to improve the design. From the rich experience of the BRIDGE project, the small group investigated one particular detail: the evolving use of audio-conferencing.

The third case deals with a hospital in Rotterdam, distributed over two locations. In order to eliminate travelling time for the joint daily meeting about patient treatment in the radio-oncology department, video-conferencing was tried and subsequently replaced by a proper teleconsulting infrastructure, which included full application sharing across locations.

From the findings of the three small groups, a number of general conclusions can be drawn. The different learning steps, as described by various models, are in practice always interrelated. Learning steps are a theoretical construct, describing different aspects of learning, not a sequential order. Also, it was noted that most issues are around group dynamic processes, not the technical use. Interestingly, psychological safety came up in two groups as a relevant factor facilitating reflective restructuring, in one case as a positive factor, in the other case the lack of psychological safety was noted as an obstacle.

A more elaborate cross-case analysis can be found at the end of Part II of this report.

The general conclusion, also elaborated at the end of Part II, is that the workshop provided evidence that the concept of learning groups is a valuable perspective for implementation of groupware. The discussion has not been finished at this workshop, it has just started. We'll hear more about this in the future.

The workshop report is structured as follows. Part I contains the workshop programme, presented theoretical concepts and case descriptions. Instructions to the small groups, their reports and the summary of cross-case discussion can be found in the part II.

Vital for good group discussions is good input from the participants. The workshop participants were asked to submit a position paper, so that we would know more or less what to expect. The collected position papers with the overview, contained as part III in this report, provide a wealth of interesting material.

Appendix A lists the addresses of the workshop participants.

Donald A. Norman (1993). Things that Make Us Smart. Addison-Wesley, Reading, MA.

Part I

Workshop Materials

Workshop Program

9:00　　Welcome, introduction of participants

9:30　　Exposition of theoretical concepts:
- Marike Hettinga: rationale for this workshop, Norman's theoretical concepts
- Ingrid Mulder: Norman's theoretical concepts applied to groups
- Gerry Stahl: social knowledge building
- Tatyana Bondarouk: experiential team learning

10:30　　Coffee break

10:45　　Presentation of case histories:
- Anabela Sarmento and João Batista: MOISIG
- Uta Pankoke: BRIDGE
- Jan Gerrit Schuurman: Hospital case

11:30　　Small working groups

12:30　　Lunch break

14:00　　Small working groups – continued

15:00　　Tea break

15:30　　Plenary:
- presentations from small groups
- cross-group discussion

16:30　　Closing
(among others: ideas for follow-up of the workshop)

Theoretical concepts (i, ii): Norman's learning concepts applied to groups

Marike Hettinga and Ingrid Mulder,
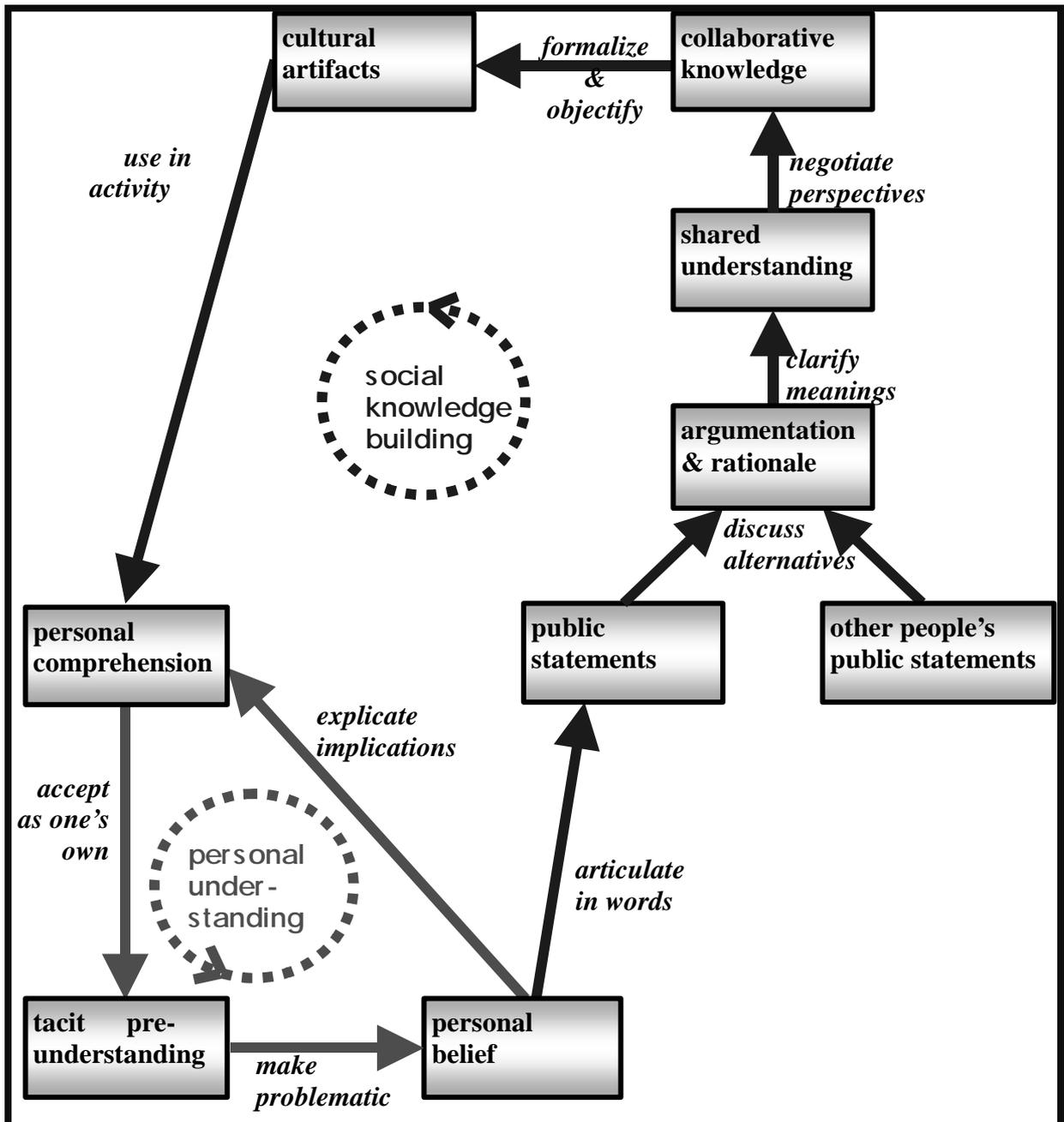
Telematica Instituut, Enschede, the Netherlands

Norman's types of individual learning	A translation of Norman's concepts to group learning concerning groupware implementation (Marike Hettinga, Michaéla Schippers, & Jan Gerrit Schuurman)		A translation of Norman's concepts to group learning with a focus on concepts rather than skills, using a distinction between individual and group learning (Ingrid Mulder)	
	Description	*Examples from use of videoconferencing*	*Description*	*Examples*
Accretion accumulating facts (experiential mode)	Group accretion: a sum of individual accretion: each individual gains knowledge and thus adds to the overall group knowledge. In the case of groupware implementation: individual group members learn facts about the new groupware through manuals, training, or using the equipment.	A radiologist tries to operate the document camera and is told (by another participant) that an image on the document camera looks different than on the monitor.	Accretion: adding or repeating concepts and facts	"We have put a design matrix." "I'm here just by myself. John is on his trip to Prague and Tom has sprained his ankle." "Next week we have a short week. We have Thursday and Friday off from school."
Tuning developing skills (experiential mode)	Group tuning can take place: · as a sum of individual tuning: individual group members improve skills in operating the groupware · as a group process: the group as a whole develops skills	· A radiologist improving her skills on operating the document camera. · A group learning how to handle interruptions when there is a delay in audio transfer	Tuning: fine-tuning of concepts (i.e., making them more specific, adding detail, adding boundaries or making the scope more explicit)	"Do they have air pressure, oil or electrical pressure?" "If it was just a single part then it was okay but the whole side panel is too big to … just feed between the roles." "So at least the clamping. Like use a power tool, and than clamp the edge around."
Restructuring building new conceptual structures (reflective mode)	Group restructuring: a group process of reflection: discussing objectives and underlying concepts; the group as a whole reflects.	Reflective discussion on goals which are not all met after the introduction of videoconferencing: the goal of discussing patients is met, but the social goals and the goal of educating assistents are not met.	Restructuring: providing new relations between concepts or a new conceptual framework (i.e., reflecting on the individual level)	"We could use the clamping like a power tool." "Perhaps it is smart, ehh, you received the AutoCAD drawing of Tom. And we several methods worked out. We just to split up, let's say, we do a few methods and you work out some methods." "We could look how to transform the concept by using a power. Let's say we have 8 concepts and look at them by the thought of that we want to use a power tool. The thing is difficult."
			Co-construction: restructuring of the whole group	*No example found in the current transcripts*

Theoretical concepts (iii): Social Knowledge Building

Gerry Stahl

Fraunhofer Institute for Applied Information Technology FIT and Univ. of Colorado
Gerry.Stahl@gmd.de

Model 1. Intertwining of tacit and explicit knowledge through various knowledge building activities.

Stahl, G. (2000) A model of collaborative knowledge-building, In: Proceedings of *Fourth International Conference of the Learning Sciences (ICLS 2000)*, Ann Arbor, MI, pp. 70-77. Available at:
http://orgwis.gmd.de/~gerry/publications/conferences/2000/icls/icls.pdf and
http://www.umich.edu/~icls/proceedings/abstracts/ab70.html.

Theoretical concepts (iv): Experiential Group Learning

Tatyana Bondarouk and Klaas Sikkel

University of Twente, the Netherlands

Group learning - behaviour that consists of actions carried out by members through which a group obtains and processes data that improves cooperation. In other words: group learning is a group interactional processes (adapted from Druskat and Kayes, 2000; Edmondson, 1999).
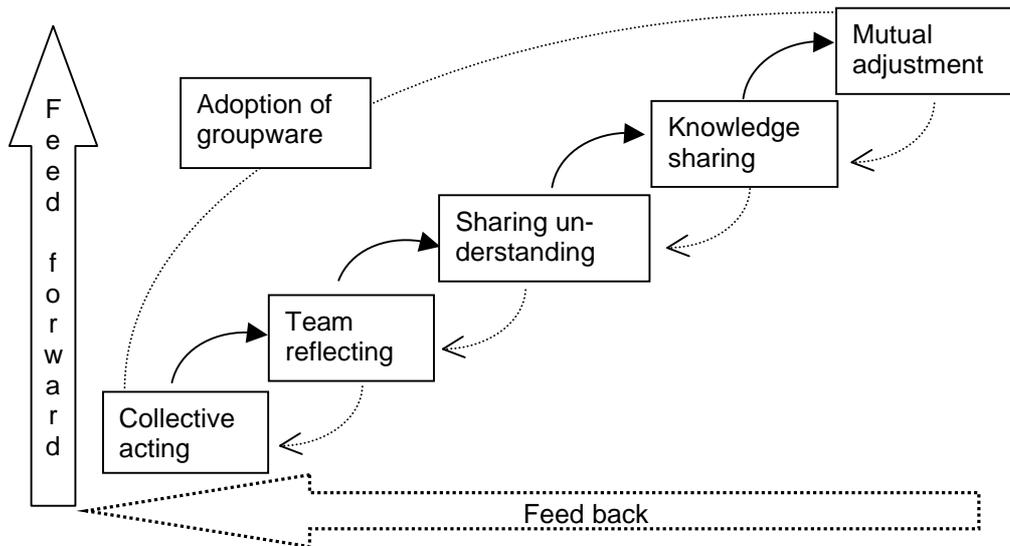
Group learning processes

Collaborative learning processes	Definitions	Activities towards adoption of groupware
1. Collective acting	goal-directed actions in order to achieve group tasks	- Replication of instructions in usual job tasks - Searching for new techniques in a system - Testing new procedures
2. Team reflecting	communicating upon group's objectives and task performing	- Discovering and interpreting a problem - Comparing with another experience - Critiquing on-going use
3. Sharing understanding	informal acceptance and respecfulness of diverse ideas and suggestions	- Demonstrating on-going use - Asking for clarification - Discussing errors
4. Knowledge sharing	product of sharing understanding	- Knowledge about intention of the system - Recognition of functional adequacy of a system - Comprehension of operating with the system
5. Mutual adjustment	group activities upon joint regulations, planning and deciding	- Developing of collective vision on a problem and a way to solve it. - Arrangements further learning activities - Evaluating intermediate results

Case History 1: MOISIG

MOISIG - A Learning Group Example

Batista, J.

Universidade de Aveiro (ISCA)
Apartado 58
3811-953 Aveiro – Portugal
jbatista@isca-aveiro.pt

Sarmento, A.

ISCAP / IPP
R. Dr. Jaime Lopes de Amorim
4465-111 S. Mamede Infesta – Portugal
asarment@mail.telepac.pt

1. Introduction

MOISIG is the **M**anagement, **O**rganisations and **I**nformation **S**ystems **I**nterest **G**roup. This group was created in November 1999 and has six members, from different scientific and geographic areas. All members are affiliated with Portuguese public universities and are involved with academic teaching and researching. The professional activities of the group members are carried out in the north and centre of Portugal.

Although they come from different scientific areas such as Management, Information Systems and Organizational Psychology, they realized that they have a common ground concerning, not only their field of research, but also the way they feel about research itself. All members believe that research is sometimes a very isolated and lonely activity (even at the level of their specialities) and that it can be more rewarding when shared with other researchers of different institutions with common interests.

The purposes of MOISIG are to share and develop their members' skills and capabilities as well as to create and share knowledge. They can be put in practice in the following ways:

- sharing learning and knowledge;
- supporting individual research;
- profiting from group synergies to do new work, like publications, participation in conferences, seminars and so on;
- developing a collaborative network with potential to create new knowledge.

It is possible to identify three phases in the development of the group: (1) focus on knowledge sharing; (2) focus on knowledge creation; (3) conciliation of sharing and creation.

2. Knowledge Sharing

In the first casual meeting members presented himself or herself and felt the need to keep in touch. After that MOISIG's development used two complementary types of communication:

- communication with electronic tools. MOISIG started exchanging electronic messages, benefiting from the potential of Web discussion groups. It was created a private mailing list using the facilities provided by egroups, and some time after, yahoogroups. This mailing list allows daily communication and reinforces collaborative learning and sharing. The mailing list's site also provided a space to store sharable artifacts;

– presential meetings. In these meetings, each member presents his or her own work, doubts and problems. All members learn contents, develop processes of share and collaboration and discuss ideas, finish group tasks and reflect about group dynamics (relations between persons, roles, responsibilities, future perspectives, etc).

The major part of the communication that occurs in MOISIG happens through the mailing list, with an average of 60 email messages per month in the first 21 months. It allows daily communication and reinforces collaborative learning and sharing. However, from time to time, MOISIG members need the richer face-to-face contact that is made possible through presential meetings.

There is a high level of trust between MOISIG's members, developed using these two types of communication.

3. Knowledge Creation

Together with individual projects, the group tries to explore one common area of interest: organisational learning and knowledge management.

To accomplish this goal, some activities have been done. Together with individual presentations the group has carried out common projects. They have prepared a few articles that they have presented in conferences (Sarmento 2000a; Cardoso 2000; Sarmento 2000b; Batista 2001). These papers are the result of the group own work. They represent common knowledge and provide a way to reinforce the group's identity and purpose while providing a way for its members to communicate with others having common interests.

In a certain moment, the group faced the fact that MOISIG materialised the concept of community of practice (CoP) presented by Wenger and Snyder (2000). The confrontation with the concepts presented in that article leaded the group to the conclusion that it is a "community of practice". In fact, the CoP's characteristics presented by the authors are the same that the group recognises in it: the purpose, who belongs, what holds it together and how long does it lasts.

One of the most important characteristics of this model is the spontaneous birth of the community. Furthermore, this model add purposes directly related with the development of the members' capabilities, and with processes of building and exchanging knowledge. In the MOISIG case, the members of this "community" select themselves, and the "passion, commitment, and identification with the group's expertise" is "what holds it together" (Wenger 2000, p.142). As for "how long does it last" it only depends on the interest of maintaining the group: it will last as long as their members want it. However, it is possible to forecast the longevity of the group if we consider the fact that "the strength of communities of practice is self-perpetuating. As they generate knowledge, they reinforce and renew themselves" (Wenger 2000, p.143).

4. Conciliation of Sharing and Creation

The next phase will be the conciliation of the two initial focus of the group's attention: knowledge sharing and knowledge creation. The group is aware that, spontaneously, it is taking a different direction from its initial goals. In fact, it is not only a group to support individual scientific projects. It is a CoP that wants to contribute for knowledge creation and participate in the scientific community.

Why has this happened? Maybe because all the group members feel that this slope meets one of the demands of academic life: to do research and, as a consequence, to communicate and share the results eventually obtained. And, also, because all the

members are motivated to carry on the project to be a CoP, after discovering that they are one.

5. Conclusions and Perspectives

For the moment, MOISIG has six members and it is not expected to grow in the near future, at least concerning the "central core". The group believes that to increase its internal cohesion, there must be a deeper level of relationship among the members as well as in the way each of the members works and contributes to collective artefacts and outputs (abilities to do some tasks).

The group has already some other projects. One of these projects involves trying another collaborative system to use together because there were some difficulties using yahoogroups. Another project is about a process of reflection about the way the group do research.

Till the moment the group has worked very well. It has lived some minor problems but it is learning how to solve them and how to grow as a group. MOISIG do not believe that it is "the solution" example. However, it is sure that it might help other groups to overcome initial inertia as well as to solve problems concerning distributed work and task coordination. The group members are aware that they still have much to learn but are sure that they already know a little bit about working together.

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Case History 2: BRIDGE

Changing Perspectives: Designers as Users

Uta Pankoke-Babatz

GMD-FIT
Institute for Applied Information Technology
Schloß Birlinghoven
D-53754 Sankt Augustin, Germany
uta.pankoke@fit.fraunhofer.de

Introduction

Designing usable groupware systems is a very difficult task. Knowledge and people from two different cultures are meeting in the design process: users and designers. Finally the designers have to design systems which meet the users need. Up to now, there is no perfect method to invest the user needs in a way enabling the design of the adequate systems [Nardi 1996; Bardram 1997]]. User needs can only be explored in real work practice and best when using an actual system [Greenbaum &Kyng 1991; Bowers 1994; Pankoke-Babatz et al. 1997].

In this contribution the differences and particularities of designers and users are looked at. A case of establishing learning situation is introduced where designers themselves learn to organise their team and their cooperation by means of groupware tools. The team process is documented over time.

Learning contexts

Users and designers act in different contexts and have different aims. The groupware system under development also plays different roles in both communities. The context in which users see the groupware system is their work and their tasks. They have to learn to adapt their tasks and work habit to benefit from the system.

In contrast, to the designers the groupware system is "their baby"; it is in the centre of their work and their interest. They understand the groupware system in the context of technical innovation, system design, architecture etc. The elegance, the technical innovation are important to them. However, in order to design suitable systems they have to understand the user's perspective [Winograd 1996].

To improve this understanding in the BRIDGE project, the system designers switched roles and acted as themselves users of the system features under design.

Designer's learning user needs through role switching

BRIDGE is an EU project with four development partners and two user sites. The aim of this project is to develop a collaborative environment. Based on existing groupware systems BRIDGE should provide awareness about mutual activities. To this end, it is necessary to understand the needs for awareness in teams using groupware.

The BRIDGE team itself is an example of such a team. To support their work they selected the following systems: email, the BSCW shared workspace system, the

audio-conference system "presence" form BT and the blaxxun community sever providing 3D worlds with chat facilities. Before the project started, all partners were familiar with email, but the other tools were only used at some sites.

The work process and the use of these systems in the BRIDGE team was documented by means of log-files, email recording and participation in the process. We could see how designers adapt the features and learn using it in collaboration. The differing needs in the various team phases and the mutual impact of technical features and social processes could be observed.

This procedure also enabled the designer to experience the tools under development from a user's perspective. If a feature is not used in the way expected, this gives clear evidence, that improvement is needed.

This procedure enables the designers to experience their own product from a very different perspective. The groupware system is now experienced in the work context and may appear quite differently as before. This experience may help them to better acknowledge the users' perspective.

Using groupware in the team

In the course of the first year of BRIDGE work we could differentiate four different phases of work. Beginning with the phase of team building, followed by a discussion phase of major project design issues, followed by the phase of producing the deliverables and groupware system specifications and ending with a phase of joint programming.

In the team building phase, awareness about the people was of major importance. Also all the systems have been explored. In the course of time the different systems found their place. Shared workspace and email became everyday tools, audio-meetings were scheduled regularly. Chat did not become a group tool, only selected people were using it. After the first six month, experimental use of the tools has changed to system specific regular usage patterns. Also conventions were set up or came into being: e.g. in case of bilateral discussions the BRIDGE distribution list was added as cc-recipient; appropriate modes for scheduling and preparing audio-meetings were found.

In the phase of producing the documents with the system specifications, awareness about the progress of work could be achieved by watching the activities in the shared workspace. Relevant topics could also be detected from reading the mail headers. Audio conferences were used to come to final decisions.

In the programming phase not much awareness about the mutual activities was requested, people did not want to be disturbed. Instead immediate reaction was requested in case of problems occurred in the joint program.

Learning from practice

It was interesting to observe that even for the designer major differences occurred between their expectations of media use and the actual usage. This confirms, that the usability of a groupware feature can only be finally evaluated through practical use. During the process of getting acquainted to new systems, the modes of using the them changed. This became evident when audio-meetings changed from a means for informal get-togethers to a medium for formal project meetings and task negotiation and assignments.

The analysis of user data has disclosed, that users achieved awareness information implicitly from media usage. For example, email topics and intensity of discussions implied awareness about the relevant issues.

It could be observed, that each phase had its own interaction pattern, rhythms and relevant media. In each of the phases, the usage and relevance of tools changed and other needs for awareness support appeared.

This raises the need to have some situative adaptation of the awareness information to be supplied.

Résumé

The behaviour of designers as users had to my understanding no essential difference to "normal" users. Although they could benefit from their technical understanding, they had to learn the usage of the systems and their integration into the team work as usual. They had to find usage conventions in the team.

This experience could help the designers to better understand the particularities of the needs for awareness support in team work.

The usage of a groupware system in the design team does not replace its evaluation in the users work processes, but it is a valuable method for pre-tests and may reduce the amount of user involvement needed and in particular it protects the users from experimenting with unsuitable solutions.

For the development of innovative features the findings about users work practices should be put in the context of social models about human activity [Leont'ew 1977; Kuuti &Arvonen 1992] and environmental conditions [Barker 1968; Schoggen 1989; Pankoke-Babatz 2000]. These should be used as theoretical structures for learning more about user's work and needs. This contextualisation may help to discover additional findings about the work process and to better predict the impacts of coming up technical features.

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Case History 3: AZR

Distributed Peer Review at an Academic Hospital

Jan Gerrit Schuurman

Telematica Instituut
Enschede, The Netherlands

Introduction

Before a patient can be treated, a treatment plan has to be made. In the past treatment plans were not systematically peer reviewed, which could lead to unsatisfactory treatment plans. Systematic collaborative patient treatment planning is of vital importance to the medical practice and therefore requires adequate support. This case is about the electronic support of medical peer review.

In the Academic Hospital Rotterdam (*Academisch Ziekenhuis Rotterdam*, AZR) the need for systematic peer review poses a problem. A so-called monodisciplinary treatment plan meeting was installed many years ago. On a daily basis radiation-oncologists, clinical physicists and laboratory personnel meet from 8.00 a.m. to 9.00 a.m. Only after approval of this board the treatment of a patient is scheduled. Notably, the AZR radiation clinic is situated on two locations: the AZR-Daniel and the AZR-Dijkzigt, which are part of the larger academic hospital AZR. The Daniel is located to the South and the Dijkzigt is located to the North of the river Maas. In a straight line the distance is less than five kilometres, but the travelling time through the Maastunnel is at least half an hour. When car congestion is serious the travelling takes even longer. This situation is problematic for the co-workers of the department of radiation-oncology. They discuss daily radiotherapy treatment plans of patients from both locations so that the highest quality standards can be met. But as a result a lot of travel is necessary and much efficiency is lost.

A solution from telemedicine was envisioned (see Wootton & Craig, 1999). In January 2001 the department of radiation oncology of the AZR employs a teleconsulting system based upon modern Internet technology. The system enables radiation-oncologists, clinical physicists and laboratory personnel to meet with their colleagues on the other side of the river Maas in the city of Rotterdam. *On line* consultation, peer review and advice about radiotherapy treatment planning eliminates the need to travel to the other location.

The teleconsulting was triggered by an organisational change. Until recently all treatment plans from the department of radiation-oncology were made in AZR-Daniel. At this location most of the accelerators, preparation instruments for moulding, simulation and computer planning are situated. However since 1998 AZR-Dijkzigt accommodates accelerators allowing stereotactic radiotherapy. This form of radiotherapy requires more precision than conventional radiotherapy. Sites and indication for stereotactic treatment include the brain, eye-melanoma, head and neck cancer, and recently also pancreatic cancer and liver metastases. CT and MRI scans are made at AZR-Daniel. But the treatment plan and the subsequent treatment take place at AZR-Dijkzigt. To ensure quality it is necessary to consult experts from the other side of the Maas. Moreover discussion of stereotactic radiotherapy treatment plans facilitates the sharing of knowledge and serves educational purposes.

First solution: Videoconferencing

At first videoconferencing looked promising. However this approach appeared insufficient for several reasons. During video conferencing it is not possible to share high-resolution images, such as CT and MRI images. In addition and even more important: video conferencing does not allow direct manipulation of the images and processing of changes. A system was needed that could facilitate the sharing of high-resolution images and that could process changes originating from two or more locations. During the meetings radiation-oncologists present their patient treatment plans to their colleagues. A crucial element of the presentation is the lightbox, a roll-about system. The series of rails hold all relevant photographs of patients. This way the group judges the plans, they can suggest improvements and if necessary corrections can be made. A system that at least supports the presentation functions of the roll-about system was required.
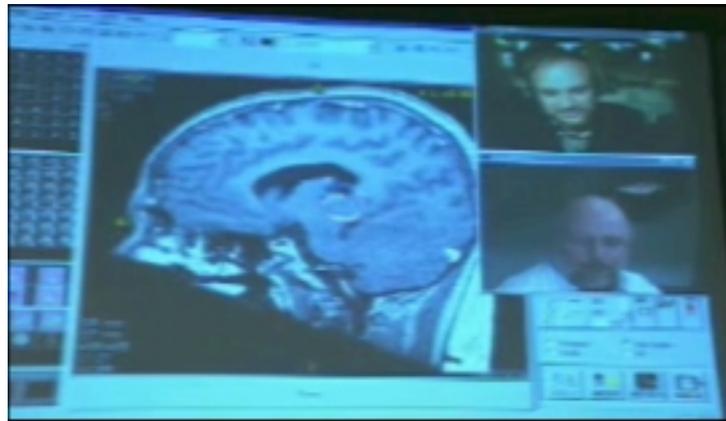
river Maas

AZR - Dijkzigt

AZR-Daniel

Second solution: Teleconsulting

Many other alternatives have been considered. Eventually a product developed at Lucent Technologies and the Telematica Instituut provided the required functionality. This so-called middleware technology delivers a software level between presentation software (from Applicare, Siemens, Philips Medical Systems, etc.) and the Internet. It supports videoconferences in combination with the collaborative use of standard applications from e.g. Office packages, and presentation software for medical images.

The network infrastructure consists of an ATM/IP connection between the two hospital locations. The connection is realised by means of a radio link, enabling 155 Mbit/s (the capacity of approximately 2000 parallel ISDN lines). The middle ware and the network infrastructure together provide the required functionality. Cameras can register events at AZR-Dijkzigt, send the images instantly and seamlessly to AZR-Daniel, and vice versa. Beamers at both locations project the people present in the teleconsulting room on the wall, next to the medical images that are visible within the same image of the beamer (see figure 1). Participants in the meetings can see themselves and can see the participants on the other side of the river Maas. Concurrently, an audio connection is established. This set-up requires 20 Mbit/s.

The shared images maintain their original high resolution. The users can decide what applications they want to share with whom. Eventually it is possible to select material from patient files irrespective its location, provided that one is permitted to access the data.

The near future

In the near future it should be possible to collaborate with experts abroad, to give consultations to medical professionals in regional hospitals or to organise virtual classrooms at a distance.This project took place in Rotterdam and was part of the GigaPort next generation Internet initiative in The Netherlands. As a GigaPort project, the aim is to generate knowledge on broadband technology for future applications through a high bandwidth network infrastructure. Applications in the medical sector show several features that are accommodated by a GigaPort network. Security measures are intrinsic to the network technology. High bandwidth can be provided for, including quality of service guarantees. Thus a session may demand the on line use of 50 Mbit/s. Unlike the Internet, GigaPort and similar networks can guarantee the allocation of the required 50 Mbit/s. Finally, billing and accounting can be automatically arranged. This is interesting when medical consultation between hospitals takes place regularly.

References

GigaPort. www.gigaport.nl

Wootton, R and Craig, J. (1999) *Introduction to telemedicine*. London: Royal Society of Medicine Press.

Part II

Workshop results

Guidelines for small groups

Discussion in small groups

Below you find the questions to stimulate discussion in your group. These questions are also a guideline for the plenary presentation of your group's results.

We split the questions in a pre-lunch and a post-lunch part. This is an indication which you can use to check whether you are more or less 'on schedule'.

Please answer the questions on the provided separate piece of paper to facilitate the writing of a workshop report.

Resources you can consult:

– a summary of each presented theory

– a summary of the case history

– the case presenter who can provide you with more detailed information on the case

Pre-lunch part

Task 1: Choose one of the theoretical concepts

1. Roughly apply all theoretical concepts to the case in order to make a well-argumented choice for one of them. Which theoretical concepts in your view provide relevant understanding of the learning processes in the depicted case study?

Task 2: Analyse the learning processes in the case with the chosen theory

2. How does the chosen theoretical concept explain the learning processes in the case study?

3. What kind of learning processes can be distinguished within the case?

4. What can you assume about reflective processes, in particular? What kind of reflection can you observe in the case?

5. Which learning processes cannot be recognised? Why?

6. How can reflective processes be improved based on the chosen theoretical concept?

7. How do learning processes influence on-going use of collaborative technologies in the case?

8. Could you propose a research instrument to analyse the match between learning processes and on-going use of technology, based on the chosen theoretical concept?

9. Other comments on the case history?

Post-lunch part

Task 3: Formulate concrete ideas/guidelines on how reflective restructuring in groupware implementation and use can be stimulated. Feel free to draw on any other experience or knowledge from the group's participants.

10. What did your chosen theoretical concept and its application on the case yield on this subject?

11. Do you know other theories or concepts that yield such guidelines? Which guidelines?

12. Do you have experience in stimulating reflective restructuring from which you can extract guidelines?

13. How should these guidelines be practically applied? (when? by whom? with what means?)

14. Any other comments and good ideas?

Task 4: Prepare a 10 minute presentation in which you cover the results of above tasks.

Task 5: Prepare questions for the cross-group discussion (see workshop program)

Working Group 1: MOISIG Case History

Group members: Helge Kahler, Oliver Klee, Ingrid Mulder, Dulce Pumareja, Anabela Sarmento, Klaas Sikkel

Report: Dulce Pumareja

Background

In this report, we present our findings and conclusions in the small group discussion over the different theoretical concepts presented in the workshop in application to a specific case. The case history we tackled is the MOISIG case of a learning group.

Case evaluation and theoretical choice

The four theoretical concepts presented in workshop namely, (1) Norman's modes of learning: accretion-tuning-restructuring (2) expanded Norman model accretion-tuning-restructuring-co-construction (3) experiential group learning model (4) collaborative knowledge building model, were examined for its applicability to the case.

Closer case history analysis revealed that several aspects of the 4 theoretical models are actually applicable to the case. However the characteristic and experience of the MOISIG group, the expanded Norman model as applied to conceptual learning (Ingrid Mulder's extension) seemed to best fit the case. The other models were not chosen due to the following reasons:

− Norman's model, Marike Hettinga's version – the aspect of co-construction is missing

− Experiential group learning – best applicable to a group handling the implementation of a technology

− Collaborative knowledge building model – best applicable to a classroom type of learning

Group learning processes and theoretical concept

In addition to accretion, tuning, and restructuring, Ingrid Mulder's model has a learning type called *co-construction*, which means restructuring of the whole group. All the different learning types were observed. An example of co-construction: during occasional face-to-face meetings of MOISIG, some time is allocated to reflect about the group dynamics and they discuss relations between persons, roles, responsibilities, future perspectives, etc. Note that Ingrid Mulder did not find examples of co-construction in her study, so we noted that the construct makes sense and we could provide an example.

It was also observed that there are different cycles of learning that took place on different time scales. At face-to-face meetings, where members present their own work, doubts, and problems, all learning steps take place in a brief period of time. But also, the development of the group and knowledge sharing and creation within the group is a learning process on a long time scale, going through a progression of different modes of learning.

Reflective processes

In the MOISIG case, reflection happens a lot. There is a lot of accretion that takes place at the individual level (as the group is generally composed of PhD students who read a lot) which is shared to the group.

In addition to the mentioned categories, we identified one borderline case between tuning and restructuring. A member of the group read an article about 'communities of practice' and realized that that is what their group has been doing all along, even before the term community of practice had acquired a significant connotation in the scientific context. We call this experiential restructuring, it is a process of reflection-in-action, an instantaneous moment in which a certain realisation is achieved out of the fine-tuning of accumulated knowledge.

Learning processes and use of technology

The MOISIG group did make use of group-based technologies such as email and mailing list (Yahoo egroups) to support each other and their collaborative processes. Some members of the group are not actually comfortable with technology and it required a certain amount of effort to be able to communicate effectively through electronic means.

In this case, we discovered that:

−   Technology can be an obstacle but in this case the group purpose was strong enough to overcome it.

    This can be illustrated by an instance in which a group member has a lot of trouble using email but continues to try using it. Another instance is when another member of the group failed to receive a message from the mailing list, and so the group reflected on using another similar technology such as GROOVE to replace egroups (currently known as Yahoo!Groups).

−   Learning results on how to work together in the past can help in supporting improving new technology implementation

    The group had a lot of experience already in configuring optimal ways on how to work together. The learning results from this experience serve as a guide for them when they begin to adopt a new communication technology for their group.

Why did reflective restructuring take place?

It is interesting to note that reflective restructuring took place so often in this group. This can be attributed to:

−   Trust

    The element of trust is a significant factor that eases the facilitation of reflective restructuring by the group. Trust is mutually effected by two factors:

    -   the group makes use of regular face-to-face interaction even though they are distributed in space;

    -   the group is a closed group. MOISIG came into existence as a group through the voluntary will of the members. At the moment, the group membership is closed to new members and any form of turnover is not yet foreseen nor contemplated upon.

−   Absence of formal leadership

    The absence of a formal leader is also a factor in facilitating reflective restructuring. The absence of formal leadership does not mean that leadership is not present. Rather leadership takes place as a shared responsibility – not as a

source of power or control – in which members take turns in managing group processes.

- The Individual and the group support each other's growth

  This factor served a big motivating factor for members to commit themselves to the group and for the group to reflect together. Members realize that they benefit something from being part of the group and so they contribute to the group's growth and development. In this way, the group and its members mutually support each other.

Guidelines & Recommendations

The following are some of the broad guidelines and recommendations to facilitate reflective restructuring that we have identified out of the case history analysis.

1. If leadership is an obstruction in the process, then distribute leadership.
2. Meet face-to-face.
3. Divide tasks and responsibility. It is important that members are made aware of their role in the group and what is the impact of their responsibilities.
4. Sustain the motivation that each member feels that he or she gains something from being part of the group.
5. In the agenda for face-to-face meetings include a certain amount of time for reflection.

Working Group 2: BRIDGE Case History

Group members: Tanya Bondarouk, Alejandro Fernandez, Ilona Heldal, Anders Mørch, Uta Pankoke-Babatz, Gerry Stahl

Report: Alejandro Fernandez, Tanya Bondarouk

Background

We present in this report the results of our discussion about different theoretical concepts presented in the workshop and their applicability to the BRIDGE case history. The BRIDGE case describes on-going use of groupware by a team of software designers. We found the case especially interesting because usually designers are associated with poor design issues, while in our group discussion we stressed importance of group processes in this particular team.

Theoretical choice (task 1)

We have chosen the theoretical concept presented by Gerry Stahl, cooperative knowledge building, as we found interesting the possibility to relate learning during implementation to artefacts, which are emphasised in Gerry's model. From the variety of groupware systems presented in the whole case study, we focused on audio-conference, where learning took place quite illustratively. One of the aims of audio-conference was to support teamwork of the designers.

Group learning processes (task 2)

In the BRIDGE case we found that different learning processes were dominating in different phases of using audio-conference. An interesting finding is that group dynamics was interrelated with learning and using the system and performing the project. The initial idea of introducing audio-conference was to support rather informal communicating among all participants. When the meeting is scheduled, all participants get together in sub-groups and use the audio support to discuss the project.

Phase I – 'team building' – was characterised with the processes of getting together and learning how to use the system. Participants had to get acquainted with each other and develop some patterns for the teamwork.

Group structural and functional characteristics (inputs to the group processes) :

- the group is not small – about 20 members.
- the work is organised in several sub-groups, which are situated in different locations. Sub-groups are remote.
- cross-functionality of the group. The participants have different backgrounds: computer scientists, software engineers, architects, lectures. They have to perform different tasks: user requirements analysis, design of software, teaching activities, different aspects of project management.

Collective acting was the major learning process in using the system. It was necessary to explore how the system worked. It became clear that in contrast with other systems (e-mail, shared workspace), audio conference could not have been developed into every day tool – there was a need for regular scheduling.

Phase II – 'discussion of major project design issues' - was characterised by intensive use of another system – e-mail communications. Therefore, audio conference was used as an additional tool to continue e-mail discussions.

Group learning mainly was based on:

− sharing knowledge (there was a need to identify relevant topics and relevant contributions)

− sharing understanding (intensive regular exchange of information and ideas).

Phase III – 'producing the deliverables and groupware specifications' – was characterised by a decreased number of e-mail communications, but an increased use of the BSCW shared workspace. The need of using audio support decreased.

Group learning mainly was based on reflecting processes (there was a need to evaluate and record progress mad by the group).

Phase IV – 'joint programming' – was characterised by a highly increased number of e-mail communications and audio conference meetings in parallel. During this phase the group had to prepare the exhibition.

It was difficult to identify one dominant learning process, as all of them played crucial role in this phase. There were a lot of questions for comprehension, spontaneous exchange of information, mutual planning and recording of progress.

By the end of the project the intention of the audio system had been changed – from the tool to organise informal meeting to the tool for formal adjustment of different managerial issues.

Reflective processes

Group reflection processes like asking questions, clarification – took place during all phases with different intensity. However, during our workshop discussion we could not identify explicit public reflection in the BRIDGE case. We came up with the idea that it was itself an interesting finding, especially when reflection had to be about problems. We think that confessing and realising a problem sometimes is not easy, that itself calls for a special attention. Two kinds of problems – poor technical and social – might lead to different individual perceptions and as a result – project outcomes.

We think that readiness to confess a problem within a group is an important factor, and it can be better achieved in a group with high level of psychological safety (where everybody can take risk to express any ideas).

There was a need in informal leadership - to take the responsibility and initiative in preparing audio meetings. Preparation itself was not easy, it required coordinating activities, motivating participants, settling the agenda of the meetings.

As a conclusion we discussed about the necessity to support group learning processes, not only reflection, but – all kinds of interactional activities. That could be done by an informal leader in the group or by a project manager.

Working Group 3: AZR Case History

Group members: Tony Hall, João Batista, Marike Hettinga, Jan Gerrit Schuurman

Report: Jan Gerrit Schuurman

Background

In this report, we present our findings and conclusions from a small group discussion concerning the different theoretical concepts presented in the workshop and their application to a specific case. The case history we tackled is the AZR, Hospital case study of a learning group.

Case evaluation and theoretical choice

Before making a choice, we first want to answer the following question, what are the theories *about*? We start with the concepts by Stahl, then move on to the concepts of Bondarouk, followed by Mulder's version of Norman's ideas and concluding with Hettinga's version of Norman's concepts.

We discuss the following points:

− What is the theory about?

− What are the positive and negative points of the theory for the purpose of discussing this case

− What does the theory say in relation to the goal of the workshop?

All theories showed the following two problems:

− The theories seem not to include group characteristics, number of participants, (co-) location, content, mode of interaction, (social) context.

− It is not clear whether the theories are used either descriptively or prescriptively.

Stahl

What is the theory about?	The theory is ethnographic, (or so it seems), being concerned with vignettes of learning, short thirty-second or so fragments of a larger learning process. The fragments are discussed and evaluated in a group of researchers: it is an interpretive approach..
Positive points in this context	− Stahl's model illustrates both personal and social learning processes, attempting to show how the construction of knowledge is mediated between the individual person and their community. This in contrast to Kolb, and his experiential model, where the focus is uniquely on individual learning. − Its explicit inclusion of information artifacts stands out as something any good theory of group learning should account for.
Negative points in this context	− The characteristics of the activity involved are not clearly located in the model.
Support of workshop goal	Stahl's theory is in our view a social cybernetic theory of group learning. It supports the development of concepts of stimulating reflective restructuring by stipulating the

	need for personal as well as social learning processes. This model provides an overall frame for understanding how knowledge and its exemplar information artifacts are socially constructed..

Bondarouk

What is the theory about?	Bondarouk's theory is about long-term learning from introduction of new technology to stable use.
Positive points in this context	– The idea of augmented feed back /feed forward continuing through the adoption of the new technology: on-going feedback.
Negative points in this context	– The theory seems not to include group characteristics, number of participants, (co-) location, content, mode of interaction, (social) context. – 'Feedback' exists in many forms; this single term negates its manifold character. – The level of individual learning seems to be absent in the model.
Support of workshop goal	As a *theory* the framework does not look helpful. But as a template it suggests support for reflection (see the three middle boxes of the model). This should be tested though: maybe one middle box is enough, or you may need more than three.

Norman - Mulder

What is the theory about?	Mulder's version is about both short and long-term learning processes.
Positive points in this context	– The framework is helpful in (1) ordering data of group learning cases and experiments and (2) in suggesting 'missing' learning processes.
Negative points in this context	– The theory seems not to include group characteristics, number of participants, (co-) location, content, mode of interaction, (social) context. – There is no process model, there is no information flow stipulated. More generally: how do the categories interrelate? – The category co-construction of knowledge seems to negate the point that accretion, tuning and restructuring are about group-learning, including individual learning, and not just about individual learning, to which the group level is added.
Support of workshop goal	The theory suggests several levels at which group learning processes have to be supported in order to stimulate reflective restructuring.

Norman - Hettinga

What is the theory about?	The theory is about individual and group learning, in the short term as well as the long-term.
Positive points in this context	– The framework is helpful in (1) ordering data of group learning cases and experiments and (2) in suggesting 'missing' learning processes.
	– The integration of individual and group learning in one framework.
	– The theory may be a scaling theory. In other words it applies to individual as well as groups, to short as well as long intervals of time.
	– In this model the group objective is met notwithstanding incompatible individual objectives.
Negative points in this context	– The theory seems not to include group characteristics, number of participants, (co-) location, content, mode of interaction, (social) context.
	– There is no process model, there is no information flow stipulated. More generally: how do the categories interrelate?
Support of workshop goal	The theory both suggests interventions on the three levels and makes explicit the interdependence of the three types of learning which have to be supported concurrently.

We think that of the four theories the Norman-Hettinga theory seems most applicable to the AZR case history because in general terms it suits the context. The theory is:

– scaling

– recognises interdepedence of individual and common goals

– notes opportunity costs with respect to individual goals to meet the common goals

There are some problems with this theory: it treats some aspects as parameters:

– group characteristics

– number of participants

– (co-) location

– content

– mode of interaction

– (social) context

Task 2

What kinds of learning have been observed in the case?

Accretion

– Group members had to learn to operate the new technology.

– The doctors had to learn to operate the interface, in particular using the mouse.

Tuning

– Tuning occurred at several levels: between leaders of the project group: only after 5-6 months the project leaders found a way to deal with their self-imposed timetable.

– Doctors learned to tune more carefully to the speaking/listening constrains of the teleconsultation.

Reflective restructuring

– All team members came to agree on new values concerning audibility and clarity of speech. When somebody speaks softly, then the participants tend to correct each other by friendly hints.

– During the project a new contract has been negotiated. The project proceeded at a slower pace after several discussions about the way to meet the ends of the project.

Guidelines and Recommendations

Our general conclusion is that the three types of learning are interdependent. Consequently if you want to support reflective restructuring you need to address accretion and tuning as well.

In order to expedite the introduction and adoption of groupware, interventions should meet these criteria. Reflective restructuring is not *just* reflective restructuring.

Note that the concrete interventions may change over time (for instance due to technological developments) but the idea of interdependence of learning types remains: it is independent of historical aspects such as technological and/or social developments.

A final point concerns the nature of guidelines. How concrete should guidelines be? We have come to the conclusion that the theory-based guidelines should support the formulation of guidelines for specific cases. To be too concrete diminishes the possibility to transfer guidelines across cases. For example, knowing that reflective restructuring entails accretion and tuning as related processes has definite consequences for the formulation of concrete guidelines in specific but different group learning cases.

Cross-Case Analysis

From the cross-case discussion after presentations in plenary we can draw the following propositions.

Firstly, *learning steps are interrelated* in whatever learning model you take. In order to make a clear model, and in order to factor out the different aspects of learning, different types of learning steps are distinguished. What several participants have observed in their own work is that in practice these learning steps are often inseparable. Also, already at the introductory presentations it was noted that there are learning cycles at very different time scales, reaching from 30 seconds to several years.

Secondly, it appears that *most issues are around group dynamic processes*, not around the technical use of a system. There are technical issues as well, but these become group dynamic issues as they interfere with a smooth working process. You could see this in all three cases. problems in email-handling with some of the MOISIG members; technical problems with audio-conferencing in the BRIDGE project; handling the difficulties of clearly speaking in a videoconference in the AZR case.

Thirdly, all groups stressed high importance of reflective processes during on-going use of groupware, but these processes are described differently by different groups. We think that there is a need in call for clarification and sharing understanding of what we mean by reflective group processes. Etc.

Fourthly, there are some noteworthy theoretical contributions to the presented concepts raised during small group discussions and can be found in their reports.

− Group 1 found examples of *co-construction*, a concept from the theoretical framework of Ingrid Mulder, but not observed in her own case study.

− Group 2 noted that *discovering, declaring and interpreting of a problem*, both on the social and the technical level, can be a problem in itself. It needs a certain level of psychological safety for a group member to state that you have a problem. It illustrated a particular kind of reflective process that was not highlighted much in the literature yet.

− Group 3 emphasized the *interdependence of the different learning steps*. Consequently, if you want to support reflective restructuring, you need to address accretion and tuning as well.

Further, there are several notions concerning group dynamics, which in practice influenced the situated use of groupware.

− *Psychological safety*.
  Group 1 stated psychological safety (or trust, as they called it) as one of the factors that facilitated reflective restructuring. Group 2, on the other hand, found that group members had difficulties to declare a problem and attributed this to a lack of psychological safety in the group.
  This seems to be an issue worth pursuing. Improving the psychological safety in a group enhances its capability for reflective restructuring.

− *Hierarchy* is a broader issue. For example, it is known from the literature that strong leadership is an advantage for introducing groupware. But this is at the organisational level. At the team level, absence of formal leadership and division of tasks and responsibilities seems to have a beneficial effect on team learning an reflective restructuring.

− *Individual and group-goals.* Group learning often requires restructuring of individual goals with respect to group goals. The process of alignment of individuals pursuing their personal goals with the group supporting the goals of the whole group is worth studying, in experimental settings as well as in case studies.

Conclusion

The workshop proposal submitted to the ECSCW conference organisation stated the following objectives.

− to acknowledge the fact that the concept of learning groups is a valuable perspective for the improvement of groupware implementation and evolution;

− to meet with researchers with similar interests and discuss future cooperation;

− to raise ideas for social and technical support of reflective restructuring.

The first point was in fact fulfilled by having the workshop. The fact that the workshop took place at a conference of high standing is an acknowledgement that it is a valuable concept.

About the second point: Yes, we did meet. Interests were diverse in the sense of research aims pursued in our own work, but there was a lot of common interest in the workshop theme. Moreover, all the participants expressed their satisfaction with the workshop.

Point three: We haven't come really very far in raising practical ideas for supporting reflective restructuring. What we did do is raise several issues that are important. Probably that is all you can expect from a workshop, but as two participants independently remarked, in order to get somewhere it helps to set your goals slightly more ambitious.

What else did we learn?

We learnt about learning theories from different perspectives: educational and psychological as well as the perspective of HCI and systems design. We learnt from practical examples. By applying the theories to the case histories, we tuned an restructured the accreted knowledge, grounded on real-life experiences and the individual knowledge of the participants.

On a different score, we learnt – experientially – that the set-up of the workshop worked. Providing well-prepared resources and concrete cases as a focus for discussion helps to induce working groups to work constructively and enthusiastically.

We got to know other participants, and learnt that they are nice folk.

The most important conclusion, however, is the following. In the goals listed above it was conjectured that the concept of learning groups is a valuable perspective. The workshop has provided evidence that validates this conjecture. That we raised issues rather than answered questions is not a bad thing. The discussion has not stopped here. It has just started. A valuable area of research has been laid out, and we will hear more of it. At ECSCW'03 or elsewhere.

Part III

Position papers

Introduction to the position papers

The participants of the workshop were requested to provide position papers. These do reveal the background of the various persons and also summarize relevant previous research experience.

There are many thematic links between the position papers and it is difficult to fit them into an orderly structure by subject. Hence in the sequel the papers are sorted alphabetically on first author, so as to facilitate access.

On the most general level, the contributions can grouped under the following broad headings:

- Support for collaborative knowledge building

- Group dynamics or processes

- Coherency between groupware design and use

Support for collaborative knowledge building

Gerry Stahl gives several models of collaborative knowledge building. When a group is provided with a new groupware artifact, it has to develop knowledge about it by developing new theories, principles and terminology. The process of constructing this knowledge can be seen as intertwining of personal and group perspectives. His paper presents a general model of collaborative knowledge building (one of the theoretical models discussed in the workshop) and three additional models for intertwining of personal and group perspectives for face-to-face interaction and two particular collaborative learning systems. Stahl has built several systems and tested these in classrooms.

Helge Kahler has experienced the implementation of groupware in various organizations and is now involved in a government project to further the use of "new media" in schools. To that end it makes sense to gain a deeper understanding of how groups of students learn together and to identify critical success factors.

It is not just a matter of bringing groupware to the classroom, as *Anders Mørch et al.* argue. In order to optimally facilitate the learning process, some interventions are needed. Interventions can come from teachers, pupils, or agents. Mørch et al. base their approach on a theory of knowledge building and activity theory. They report about two case studies. Incidentally, the pedagogical concepts of one of the groupware systems used, called Fle2, is explained in more detail in Stahl's contribution.

The idea that effective social intervention is needed to make groups of students engage in collaborative learning is also the subject of the paper of *Tony Hall*. Moreover, the technology has to fit the politics and sociality of the learning context.

Group dynamics or processes

Ingrid Mulder focuses on shared understanding in groups. A distinction is to be made between the process of reaching shared understanding and the resulting understanding. She devised a coding scheme to analyse transcripts of video conferences. In addition, a questionnaire was used to measure the participants' perception of shared understanding. There seemed to be little reflective activity, which raises the question whether it may be more difficult to express this in technology-mediated interaction.

Lack of reflection in groups is also discussed by *Marike Hettinga, Michaéla Schippers and Jan Gerrit Schuurman*. Foregoing research has shown that in general, people in organisations do not reflect spontaneously. Hettinga et al. distinguish between first-level and second-level reflection, in accordance with single-loop and double-loop learning. A questionnaire among medical doctors participating in teleconsultation sessions revealed a gap between preferred and actual reflection on both levels. Hence reflection needs to be organised, but the question of how to stimulate second level reflection is still largely unanswered.

Interaction in a distributed group of Portuguese scientists, called MOISIG, is touched upon in the papers of *João Batista* and *Anabela Sarmento*. In contrast to the studies of Mulder and Hettinga et al., reflection did seem to work in the MOISIG case, which also provided a case history for the workshop. Batista has a professional interest in Communities of Practice. Sarmento studies the impact of workflow systems in organisations.

How do groups interact in media like Collaborative Virtual Environments, and how does it differ from real life? *Ilona Heldal* has an interest in the social implications of Virtual Reality and the usability of CVE's. Apparently there is a lack of usability research in VR.

For introducing a groupware system into an organisation, *Tatyana Bondarouk and Klaas Sikkel* conjecture that the purposeful creating of a learning atmosphere in the organisation will support the implementation process. A study was carried out to determine the learning constructs at the individual and the team level.

Coherency between groupware design and use

Uta Pankoke-Babatz has positive experiences with designers themselves using a system they are designing. This does not replace requirements analysis and system evaluation in the work place, but it is a valuable method for first testing and may reduce the amount of user involvement needed, as it helps to detect usability problems before the system is tried on real users.

The implementation and use of groupware systems is an evolutionary process*. Dulce Pumareja* raises the issue of how to cope with requirements from the user group that evolve accordingly.

When the use of a system is to evolve over time, as a group restructures its work, the question is how to design systems so as to allow maximum flexibility. *Alexandro Fernández and Jörg Haake* are concerned with tailorability of groupware systems and investigate an approach to integrate the process of collaborative tailoring in the system itself.

Learning Groups: The Case of Communities of Practice

Joao Batista

ISCA - University of Aveiro

Apartado 58, 3811-953 Aveiro

Portugal

jbatista@isca-aveiro.pt

From the literature, we can find several views and trends about organizational learning, knowledge management and related concepts. The diversity of existing positions and theories prevent us from distinguishing clearly all these views. However, it is possible to distinguish them in some ways. For example, we can find "technical" and "social" views of organizational learning (Easterby-Smith 1999, 3). We can also find knowledge seen as an "object", "embedded in people", and "embedded in a community" (Wasko 2000, 156).

In organizations, an important part of learning and the associated knowledge comes from the social context. In social context, the members of organizations interact, share information and promote creation of new knowledge. The resulting knowledge does not exist, necessarily, "embedded in people", nor does result, necessarily, from technical operations. The resulting knowledge does exist in some social context, which can be organizational or interorganizational.

We are particularly interested in one specific kind of social context, namely Communities of Practice - CoP (Lave and Wenger 1991; Brown and Duguid 1991; Wenger 1998). CoP's are characterized, at least, by three concepts (Wenger 2001): the existence of a common **domain**, the **community** that results from the interactions of the members, and the **practice** shared by the members of the community. It is possible to point out other important characteristics (Hildreth 1998).

I'm involved with the CoP concept at least in two ways. One is with the MOISIG[1]. MOISIG has being accepted as an interorganizational CoP (Batista 2001; Cardoso 2000), and has six members, from Portugal. Their members are from different organizations and are almost all non-collocated. For this reason, they systematically use groupware tools to communicate, like a mailing list and a private site, since November 1999. Of particular importance, all the processes of sharing information, and the creation of new knowledge are registered in the mailing list. The group conducts its own projects. As an example, the group is now developing one particular project about collaboration with peer-to-peer (P2P) software tools (Lousã 2001). MOISIG believes that there is some kind of group learning happening in this group and that the result of this learning affects the organizations where members belong.

I'm also involved with the CoP concept in another different project. This other project arose from the need to rebuild a syllabus of an academic course. Difficulties of communication between faculty, students and former students of this course lead to this project of creating a CoP related with the course, involving faculty and students and using electronic tools. This project is now on his first action research cycle, and it is supposed that some group learning will come up from this effort. We are also interested in the fact that the organization can learn with this project.

My interest in participate on this workshop is, then, twofold. In one side, I would like to share these experiences with the other workshop participants, hoping to be helpful. On the other side, I will certainly learn a lot from the other participants. And, most important, probably we all learn something in-group.

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Cooperative Learning in Groupware Implementation

Tatyana Bondarouk
Faculty of Technology and Management
University of Twente, Enschede, the Netherlands
t.bondarouk@sms.utwente.nl

Klaas Sikkel
Faculty of Computer Science
University of Twente, Enschede, the Netherlands
sikkel@cs.utwente.nl

Introduction

On-going use of collaborative technologies is a topic of continuous interest for researchers in the CSCW community. As such technologies become progressively more intertwined in the operations, products, and infrastructure of companies, it is crucial that the implementation be successful.

However, researchers have noted widespread failures in this process (Grudin, 1988; Earl, 1993; Premkumar and King, 1994; Rogers, 1994; Fitzgerald, 1998; Gottschalk, 1999). Why is implementation of groupware in one organisation more successful than in another? We believe that social issues around implementation of the system play an important role in this process.

In the BITE research project at the University of Twente we are concerned with social problems involved in on-going use of groupware. Taking into consideration the nature of groupware, we think that especially group processes, such as collaboration among users, influence adoption of the technology.

Therefore we propose to look at the implementation of groupware from a group learning perspective. Group leaning is understood as group interactional activities. Research questions of the project are: What are the learning characteristics of evolutionary adoption of groupware? Which steps form the process of evolutionary adoption of groupware? What is the role of the team and individual learning characteristics as contextual constructs in the implementation process? Do the learning processes influence the stable use of groupware?

Why is the learning approach relevant?

We conjecture that purposeful creating of a learning atmosphere in a company will support the process of groupware implementation. This is based on three reasons:

− Groupware technologies require cooperative work. Different studies in human resource management have suggested the interdependency between cooperative work and learning, which is known as cooperative on-the-job learning, where the work socialisation plays the crucial role (Marsik and Watkins, 1992, Dixon, 1994;

Swieringa & Wierdsma, 1994; Onstenk, 1995; Watkins & Marsick, 1996). A lot could be gained from the system if people would learn from their own experience and share knowledge during the whole process of implementation.

− After groupware is deployed, people have to learn how to use a new system.

− Changes in technology inherently lead to changes in different aspects of professional competency because employees act with technology on the basis of their understanding of it, previous experience and personal learning characteristics.

Understanding of goupware implementation

In order to gain insight into how employees collectively operate with a system. we describe this process from a *cooperative on-the-job learning* approach. The basis for the model is founded on Kolb's psychological concept of experiential individual learning (Kolb, 1984) and transferred into a cooperative cycle. The latter reflects the team learning processes such as collective acting, group reflecting, sharing understanding, sharing knowledge, and mutual adjustment.
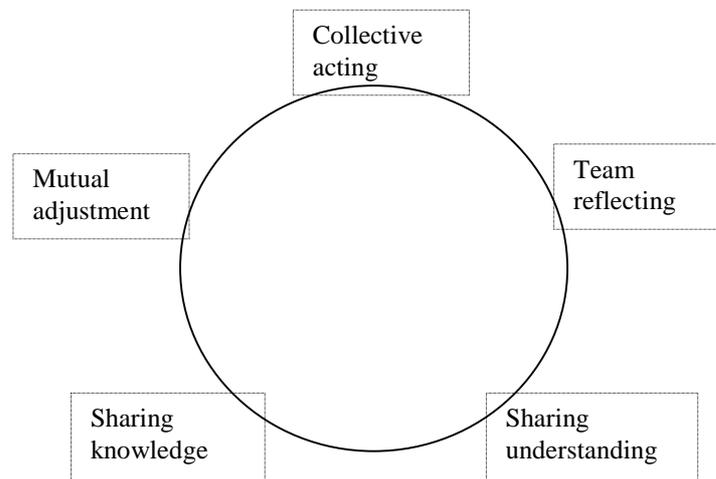
Figure 1: Cooperative learning cycle based on the Kolb's (1984) experiential learning cycle

In a first explanatory case study, the team learning processes could be operationalized to concrete group activities. Next, we are to develop measures for the learning constructs at the team and individual levels and correlate them with the evolutionary process and the indicators of groupware implementation. Two rounds of the same quantitative and qualitative methods should allow us to investigate the evolution of those constructs in the use of groupware.

Our interest in the workshop

Input we can provide to the workshop is an elaboration of the experiential group learning approach and a case study currently carried out. We are willing to share our first experiences in this area and we hope to learn from the insights, experiences, and feedback of others. Also, we are very interested to get into contact with other researchers with a similar interest, with the prospect of a continued exchange of ideas and possible further cooperation.

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Reflecting groups: collaborative tailoring as improvement of practice and practitioners

Alejandro Fernández and Jörg Haake

Motivation

The lack of matching between the original requirements for a groupware system and the real needs of the group using it has already been identified as one of the most relevant problems in groupware development. Tailorability of groupware has been identified as one of the possible solutions ([1], [7], [2]). Providing means of adapting the groupware system allows tuning it to the changing needs of the group.

Although there are technical approaches to combine tailorability and groupware ([1], [3], [10]) studies demonstrate that if the process of tailoring itself is not supported then tailoring does not take place effectively ([5], [4] [8]).

Tailoring groupware can be seen as an process of reflection done by teams members in collaboration that has as the main result the improvement of the practice. Mackay's work [5] (in concordance with the motivation of this workshop) provides evidence to conclude that in reality not enough opportunities for improvement are identified. This also counts for opportunities of sharing experiences in using and improving the groupware environment. We believe this lack of participation is mostly due to a currently incomplete understanding about the mechanisms that rule tailoring as a collaborative, restructuring activity.

In order to develop groupware environments that stimulate reflective restructuring we need to:

- Support the process of tailoring as a team activity.

- Include explicit support for team reflection.

This would have direct impact in users participation as they will clearly see how this extra work translates to improved practice.

Following we briefly describe each of these requirements to give an idea about how covering them would solve the problems that currently hinder collaborative restructuring.

Supporting the process of tailoring as a team activity

As we have already indicated, most research on support for tailorable/adaptable groupware concentrates on developing support for end user programming or customization on the functional level. For example, Bentley [1] focuses on providing a "medium" that can be tailored to suit the needs of participants and around which work can be organized. He emphasizes medium rather mechanism and

talks about incremental customization where different levels of customization require different levels of expertise. MacLean [6] goes a step further buy combining the technical approach of incremental tailoring of button with a organizational model of tailoring with the goal of establishing a tailoring culture. However, the systems developed in both cases do not provide more than specific types of high level programming features and mechanisms.

We look for an approach that integrates the process of collaborative tailoring in the system itself therefore transforming restructuring in one more of the tasks that the group must perform. In such system, the following requirements should at least be covered:

- Reduce the work needed to tailor the system. This could be approached by allowing the system itself to automatically apply customizations chosen from a pool of available ones.

- Explicitly support sharing of customizations as this clearly reflects how practitioners learn from each other.

- Provide mechanism to understand motivation, design and implementation of a given customization.

- Provide mechanisms to document requirements, constraints and expectations of impact for customizations. This would help finding adequate customizations.

- Provide mechanism to assess the quality and impact of customizations before any sharing is done (build trust).

- Provide mechanism to assess the usefulness of customizations in a reflective way (being able to relate customization to work practices).

- Avoid non-effective/useless tailoring.

Including explicit support for team reflection

Tailoring is no other thing than reflection in action [9]. Practitioners, base on their personal experiences, identify problems or opportunities for improvement. Experimentation alternates with redefinition of the problems until a balance between forces in the problem and solution has been reached.

Tailoring is a learning activity that bring for the practitioner new insights in the ways work is performed. Although this experience is difficult to share, the results are integrated back into the system improving how others do their work. In the context of groupware we must keep in mind that reflection is performed by teams. There are now groups of practitioners identifying and reframing problems and experimenting with alternative solutions. Therefore, support for collaborative reflective restructuring should at least cover:

- Help groups identifying opportunities for innovation and sharing.

- Help groups identifying need for improvement (in the presence of problems).

- Identify stakeholders and views to involve them in those changes that will impact their way of working.

- Support collaboration in framing and reframing the problems that need to be addressed. Make sure that problem statements include a detail description of the forces in play.

- Support harmless test of alternative solutions until an effective one has been found (experimentation). Make sure solutions are accompanied by a description of the context where the solution applies and the expected results.

In progress

The requirements that we enumerated in the previous section are covered in a system being developed at GMD-IPSI. Such environment complements the tools that are already in place for supporting collaborative work in Extended Enterprizes within the context of the project EXTERNAL (IST-1999-10091). Our attention is focused in particular in customization of worktops. A worktop is a dynamic representation of the work space of a user which includes the resources and tools he needs at each point in time as well special artifacts monitoring his/her interests.

Our approach can be shortly described as providing:

- Simplified tailoring through automatic, intelligent sharing of tailoring artifacts.

- Assisted identification of improvement opportunities.

- Support for explicit specification of motivation, goals and expectations.

- Assisted evaluation of impact of customization in performance of the.

- Support for collaboration in the design, implementation and harmless experimentation with tailoring artifacts.

Participating in the workshop would mean for us the opportunity of discussing this approach with colleagues exploring the same area. It would as well provide us with the methodological background needed to support our approach. Our position is that integrating support for the process of tailoring in groupware systems will have have as a result a more active participation in reflective restructuring. In order to achieve this we need to understand how tailoring as a continuous learning activity takes place.

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Novel Technology, Novel Thoughts: Prospects for Computer Supported Critical Thinking

Tony Hall,
Interaction Design Centre,
CSIS Department,
College of Informatics and Electronics,
University of Limerick,
Ireland.

tony.hall@ul.ie

Introduction: background and interest in the learning groups workshop

My interest in this workshop and the use of technology to support learning groups comes from my academic background and personal experiences of work. My primary degree is in teaching, physical education and English literature and pedagogy, from the University of Limerick, Ireland, 1998. I've also trained as a foreign language teacher, completing the Cambridge University/RSA (Royal Society of Arts) Certificate in Teaching English as a Foreign Language to Adults in 1996. In 1997, I completed the Certificate in Computing by distance learning with the Open University, England, before graduating with a master's degree in information technology from the National, University, Galway, Ireland, in 2000. I have also taught at primary, secondary and tertiary levels and worked in the commercial sector as an Internet programmer, developing intranet and extranet applications for an investment bank and civic body respectively. My work in the banking and public sectors involved creating multimedia educational and training material. I've also worked as an instructional designer for an e-learning company, developing electronic training courses on operating systems and programming languages. I formerly taught computer studies, physical education, English, history, and economics, and explored the use of ICT in the teaching of these subjects.

These experiences, academic and professional, have formed my interest in learning groups and the prospects of supporting collaborative or group learning using technology, confirming, for me, how learning is socially based and constructed. Furthermore, these experiences have shown that there is a significant distinction to be drawn between "information" and "informing". While learners might receive large amounts of pertinent data through sophisticated electronic means, this does not guarantee that the newly available data or information will make a positive impact, either on their performance or enjoyment of what they are doing in the workplace or classroom. There is a wider context of learning support, beyond technology, that encompasses social and political issues, which requires consideration.

I am particularly interested in how we might deploy technology so it serves as a cognitive or intellectual tool, how it might facilitate 'higher cognitive' learning or critical thinking, or what Norman terms "reflective restructuring" [1].

Instructional design-like content delivery and management or un-moderated information sharing are not, it seems, sufficient to instil higher cognitive learning like critical thinking

or reflective restructuring, the type of learning that enables one to effect positive changes in one's work-practices or in one's motivation for work, for example. As Bruner argues, it is more a matter of 'learning to be' rather than 'learning about', more to do with learning dispositions than learning data [2]. Therefore, for learning groups to work optimally they require more than just very sophisticated technology, they furthermore require other, effective social intervention. At the workshop, I would like to explore with colleagues what this social support might consist in.

Again, learners require the skills to apply what they learn, to motivate positive changes and improvements in their work. For me, it is simply not possible to code a surrogate for good pedagogy or teaching, rather, what is required, to encourage reflective restructuring, is technology that fits with the politics and sociality of the learning context, so it effectively supports collaboration between the different partners involved, notwithstanding the form of partnership they enter into, learner-teacher, learner-learner, learner-expert etc.

Thoughts on technology and higher cognitive learning

Although I'm still really just embarking on my research on the scope of technology to facilitate reflective restructuring in groups, in contexts like the classroom, and lecture hall, for example, I've recently experienced the diametric positions and panoply of negatives and positives about technology and its potential to support meaningful learning in groups.

I recently attended the Seymour Papert MIT Media Lab Europe guest lecture at St. Patrick's College of Education, Drumcondra, Dublin. According to Papert, to facilitate reflective restructuring, we must radicalise and overhaul completely learning using new media and technology. For Papert, the answer to learning problems, individual or group, in the workplace, classroom, or lecture hall is not to use "the new medium to do the old thing" [3], but to provide for new learning experiences, content, processes, pedagogies, using new media and technology. Papert's lecture was firmly anti-traditionalist about technology and learning in groups.

However, I also recently read Clifford Stoll's "High-Tech Heretic – Reflections of a Computer Contrarian", which was, contrariwise to Papert's lecture, strictly along traditional lines, and in which the author, writing about technology and young learners specifically, observes: "There's a difference between having access to information and having the savvy it takes to interpret it. Lacking critical thinking, kids are on-screen innocents who confuse form with content, sense with sensibility, ponderous words with weighty thought." [4] Stoll's book was firmly traditionalist about learning in groups and almost wholly anti-technology.

While it's been interesting to consider these two polar, opposite stances about technology and learning, one (Papert) very optimistic about the potential of technology to facilitate learning in groups, the other (Stoll) utterly pessimistic about the potential of technology to facilitate meaningful learning, either individually or in groups, it's also been insightful.

Listening to Papert and reading Stoll, the research question arises: how do we design interaction with and between technology and people to support educators and trainers in

helping learners to reflect in restructuring ways, in contexts like the workplace, school, and university? On first reflection, the answer seems to lie in designing evolutionary groupware so it provides for an appropriate balance between interpersonal interaction between learners, their peers and their tutors and interaction between learners and the technology. People can learn content from technology but without the critical skills to apply the content and effect positive changes in how they think, emote and act, that content becomes meaningless. At the workshop, I would generally like to discuss the aforementioned issues regarding how we might orchestrate interaction between people and technology to facilitate reflective restructuring in learning groups.

Concluding thoughts: reflective restructuring and mobile work

Also, as desktop PCs become obsolete, and technology becomes subsumed in the world around us, and as ubiquitous electronic devices begin to pervade, we should, it seems, begin to consider how we might design evolutionary groupware so that it supports dislocated or mobile reflective restructuring by learning groups. This seems especially important given the changes that are currently underway in work organisation, from traditional forms of cubicle culture to innovations like hot-desking and nomadic working.

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On the Usability Concept for Collaborative Virtual Environments (CVEs)

Ilona Heldal
Department of Technology and Society
Chalmers University of Technology, Gothenburg, Sweden
ilohel@mot.chalmers.se

Our group, at my department, are doing research in social implications of virtual reality. There are ongoing projects about how certain virtual reality equipment influence social collaboration and co-work, what are the implications of networked virtual reality systems (depending on the technology or on the used context) etc. For example, what kind of virtual reality system (Cube-type systems, HMDs, or desktop systems) is the most suitable for a particular task? What kinds of communication modalities are most suitable for certain immersive and non-immersive VR systems?

There are many practical applications that demonstrate the importance and the effectiveness of usability studies for computers and software systems. They are based on studies (guidelines, evaluation methods) defined in the 1980s, by Schneiderman, Norman, and Nielsen etc. Although, there are new usability researches done for CVEs, they are still based on the old studies. Some typical characteristics of CVEs, for example:

- the 3rd dimension (representation of, navigation in, etc),
- the different representation depending on the used technology (differences between the used system: a non immersive system, like a desktop computer from a full immersive VR systems, for example Cave-type systems or HMDs),
- user-group characteristics (group size, experiences, pre-knowledge, etc),
- collaborative task characteristics (co-work, learning, games, social discussion-groups, etc),
- communication modalities (text, audio, graphics, etc),

are not taken in consideration, maybe only a part of them. .

My research interest is based on the following hypothesis: *The recent changes observed in the computer interfaces are not followed by changes, on the same level, in the usability research.* There are new, networked and social characteristics of computer applications, which are not mentioned in the usability evaluations. Today the computers are extensively used for communication, quite broadly for human-to-human collaboration, although they were designed, from the beginning, to perform computations.

The new features, that allows communication, are built on the same machine – maybe with faster and more powerful memory –, or on the already existing communication devices, as the telephones and PDAs – which looks like some mini computers –. They follows pretty much the same principles and design like the computer interfaces. That means that the new changes that allow communications also inherited their look from the previous computer interfaces. That is true for the new virtual reality devices as well. We can miss important aspect acting in a same manner for the new networked applications as for the older ones defined by HCI usability methods. As an example new type of problems can occur in circumstances when the connected devices are not the same type. Mobile phones can be connected to desktop computers, desktop computers to power-walls or maybe to some virtual reality devices.

Research demonstrated that people act differently in these not symmetrical conditions. Those who works with more advanced devices can contribute more in solving concrete tasks (Axelsson, 1999; Slater,1999; Wideström, 2001; Schroeder, 2001). There are also differences in task performance using different technological solutions.

There are done usability and use oriented research about distributed, networked applications in several HCI related, and somehow overlapping fields, like CMC, Computer Supported Collaborative Work (CSCW), decision groupware systems (DGS), information systems (IS), multimedia, ubiquitous computing and so on. But yet, as I know, there are no usability evaluation methods, where findings from the use of networked communication, or social interaction via computers are also treated in the usability evaluation method.

A possible reason can be the following: A usability study has to be done easily and quickly. But, human communication and social interaction is not easy, nor quick, neither deterministic, and the communication systems that supports these applications also are complex. Results regarding social communication are quite often based on context dependent investigations, in contrast with the general guidelines suggested by HCI. There are evidences that show that following existing evaluation methods, with the main guidelines from HCI, results in better products. Maybe it should take longer time and more resources to redefine and to reuse those context dependent methods, which give social guidelines, although they can fit better the newer application with a higher level of complexity. But the fact, that research from different social and human studies already produced valuable results, pointing out contra intuitive aspects for the newer media, makes it worth to prove it. A better understanding on methods and considering the guidelines regarding social communication, and about how, why, and in which phases of the usability evaluation they should be taken in consideration, should result improved applications that supports human to human communication.

The CVEs has to deal with groups of different size, communication between different cultures, and also the tasks and the use context can vary a lot. There could be a benefit, for CVE designers and other developers as well; to know about differences in group communication via media from human the studies.
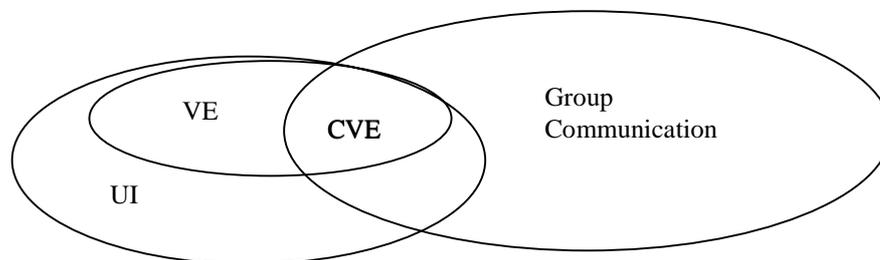
Figure 1. Group communication and user interfaces.

Since my interest is usability, and learning plays an important roll for it, this workshop can be important for my research. -- According to Nielsen (Nielsen, 1993), to check the usability of a system, we have to see how easy it is to learn, how efficient it is, how easily the users can remember it, how many errors they make, and how they are pleased with the system.

During the workshop I would like to discuss questions like:
- How the context (about users, system, and task) influences different learning phases? How the users (group) pre-knowledge influences the different learning phases?
- To determine the usability of a virtual reality system do we necessarily need to make comparisons with real life settings? In particular: how learning in virtual environments can be compared with learning in real world? How it is individually, and how for a group?

- What does a poor performance and poor learning mean? What is the correspondence between that in the real life, and in VR? Does a bad performance in real setting and in VR means good usability?

Practical Projects

1. Molecule visualization.
   The purpose of this study was to investigate which virtual reality equipment can be considered most usable in relation to a specific virtual model. In this case we compared an immersive (Cave-type) and a non-immersive (desktop) environment used for visualizing a complex molecule. We examined the same model during three trials carried on three different occasions with a total of more than 100 student subjects. The users had to identify different atoms, to remember structures, and to could navigate in the virtual molecules. In these trials, we were interested in a range of issues, including presence, collaboration, navigation and the usability of the model.

2. Puzzle solving.

   We compared performance and experience in solving a 3D cube puzzle between four conditions: two participants in real space (R trial), both participants in different Cave type environments (C2C trial), one participant in a Cave type environment and one on a desktop system (C2D trial), and one participant in a Cave type environment and one with an head mounted display HMD (C2HMD trial). The participants in the R trial performed the task with real blocks.

3. Long-term use.
   To investigate long-term uses, we carried out an exploratory trial whereby four participants took part in 10 one-hour meetings in a desktop VE, Active worlds. This would allow us to examine the problems and changes that took place over the course of these meetings. The aim was to explore both technical and social problems.

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Invisible forces in favour of the status quo: Stimulating reflective restructuring

Marike Hettinga

Telematica Instituut, The Netherlands

hettinga@telin.nl

Michaéla Schippers

Vrije Universiteit, Department of Work and Organizational Psychology, The Netherlands

mc.schippers@psy.vu.nl

Jan Gerrit Schuurman

Telematica Instituut, The Netherlands

schuurman@telin.nl

Abstract

Reflection is considered as an important condition for bringing about organizational learning. In this research two levels of reflection are discerned, based on Norman's two kinds of cognition. Foregoing research has shown that in general, people in organizations do not reflect spontaneously. The current research had two aims: First assessing whether people experience a gap between preferred and actual reflection and second to get information on how reflexivity could be enhanced. This was done by means of a survey and group discussion among three videoconferencing groups. It was concluded that people experience a gap between actual and preferred reflection. Furthermore, people indicated that first level reflection was far more common than the second one. Participants indicated that a facilitator was needed for stimulating reflection in the groups and that reflection preferably should be organised on a regular basis.

Background

The study described in this paper springs from two Ph.D. projects: 'EVOLVE' and 'Reflexivity in teams'. These two projects started in different disciplines and originally concerned different topics. However, both projects converged to the question how reflection can be stimulated. In the following two sections we describe the two Ph.D. projects.

EVOLVE

New technologies are not used in the way and for the purposes they were designed for. Users tend to 're-invent' technology – they develop their own way of using it for their particular purposes, and they may invent completely new purposes (Bikson & Eveland, 1996; Orlikowski, 1996; Orlikowski & Hofman, 1997; Rogers, 1994). Briefly said in our own words: the use of technology evolves.

The common meaning of the word evolve is: 'develop naturally and (usually) gradually' (Hornby, 1989). We used the word as an acronym, forming the title of our research with the meaning: EVOLutionary aspects of Videoconferencing Explored. The above named studies involved groupware applications like a group decision support system, a workflow system, and a multi-user booking and ticketing system. We wanted to know whether similar change processes took place concerning videoconferencing. And if so, how these change processes could be supported.

To answer these questions we performed three long-term case studies concerning teleconsultations between physicians of regional hospitals and physicians of academic hospitals. In these sessions the former seek advice on the treatment of cancer patients. The teleconsultations are supported by videoconferencing equipment that also provides the sharing of X-rays and microscope images.

In contrast to our expectations based on the above named literature, we did not observe significant changes in technical, task, or social structures. We performed a conversation analysis of sessions during a whole year and extracted the moments of reflection, which we called breakdowns. We learned that these breakdowns concerned mostly facts about the equipment or skills in operating the equipment. The breakdowns hardly ever concerned the underlying concepts and values. Also, most of the breakdowns occurred soon after the introduction of videoconferencing. In a later stage, hardly any reflection occurred. These findings are in line with former research of (Tucker, Edmondson, & Spear, 2001). In their research among nurses, they observed the way problems were usually handled, and the extend to which the nurses learned from their experiences. A problem was defined by them as an undesirable gap between an expected and observed state.

They found that in 92% of the cases, nurses chose for the strategy of fixing the problem (first order problem solving, analogous to single loop learning) and in only 8% of the cases they chose for diagnosing and altering root causes to prevent recurrence (second order problem solving, analogous to double loop learning). From this research it can be concluded that people in general do not reflect spontaneously, despite the fact that doing so can prevent problems from recurring in the future and might enhance working more effectively. One of the main reasons mentioned by (Tucker et al., 2001) is the organizational context, fostering short-term solutions like first order problem solving. Second order problem solving often requires communicating with others on the subject and is often more time consuming because one has to search for the cause of the problem.

We assumed that reflection on underlying concepts is a crucial element of change processes (Argyris, 1992). In our further study of how to support a change process, we focused on how to stimulate reflection. However, literature and former research did not yield more than a few general guidelines, instead of concrete guidelines.

We aimed at extending these general guidelines by consulting the case study participants on how they could be stimulated to reflect on a conceptual level.

Reflexivity in teams

Reflexivity -the extent to which teams reflect upon and modify their functioning- has been identified as a possible key factor in the effectiveness of work teams, especially those that operate in uncertain, challenging environments. When members collectively reflect upon their objectives, strategies, processes and wider environments; plan to adapt these aspects of their taskfunctional worlds and make changes accordingly, teams will be more effective. Such teams are expected to be more innovative and client oriented and make better quality decisions. Team reflexivity is defined as the extent to which team members collectively reflect upon the teams objectives, strategies and processes, as well as their wider organizations and environments, and adapt them accordingly. Non-reflexive teams show little awareness of the team objectives, strategies and the environment in which they operate. Such teams are inclined to be reactive rather than proactive and react defensively in case of environmental threat. Reflexive teams show a more detailed planning, pay more attention to long-term consequences and have a larger inventory of environmental cues to which they respond.

Reflexivity is described as a process with three components: reflection, planning and action. A model of reflexivity and its antecedents (e.g. team leadership, task characteristics), process (e.g. team reflexivity, feedback seeking behaviour) and outcomes (e.g. performance) was developed.

A first aim of the study was to develop a questionnaire to measure (aspects of) reflexivity. Two factors of reflection were identified. These were labeled

evaluation/learning and discussing processes. A second goal of the study was to explore the relationship between reflexivity and related variables such as leadership, shared vision, trust, error management, feedback seeking behavior, group potency and job demands. Moderate to high intercorrelations were found between most of the variables, however, the two scales measuring reflexivity were differentially related to some of the variables. A third aim of the study was to assess the relationship between reflexivity and team performance. Results show positive relationships between reflexivity and two measures of performance, namely self-reported performance and supervisor rated performance. Interestingly, while evaluation/learning was more strongly related to subjective performance than discussing processes, the reverse was found for externally rated performance, discussing processes had a stronger relationship with externally rated team performance than evaluation/learning.

The participating teams received feedback on their results. Most of the teams acknowledged the need for reflection. They were usually not satisfied with the amount of time spent on reflection. However, because of daily hassles, teams often did not reflect spontaneously on a regular basis. The question that consequently remained was how to stimulate reflection in teams. The current study was aimed at answering this question from the viewpoint of people in the organization.

Reflection

Reflection seems to be important for team functioning. However, teams are nor spontaneously reflexive. Organizational objectives and the organizational culture are considered as givens and often not under discussion (Allen, 1996). Teams tend to behave in habitual ways, even when faced with evidence that this behavior might be dysfunctional in reaching the team and/or organizational goals (Gersick & Hackman, 1990). Clearly, research is needed to assess whether and how reflection of teams in organizations can be enhanced and how reflexivity can become customary for teams and built into their daily functioning, rather than a short-lived trend after a team training (Schippers, Den Hartog, & Koopman, 2001). The guidelines for enhancing reflection, that can be found in the literature, give some guidance. However, little is known about the way in which reflection can be enhanced in teams, and how exactly this reflective openness should be brought about and by whom. It is also not clear whether teams are convinced of the benefits of reflection. Most teams have to contend with high work pressure, and may see reflection as a time-consuming activity, while at the same time recognizing its potential benefits.

In both Ph.D. projects we distinguish several levels of reflection. These levels of reflection are similar to the three kinds of learning distinguished by Norman

(Norman, 1993). In this section we describe his theory of two types of cognition and three types of learning. We also describe how these relate to the two levels of reflection we distinguish in this study. We end this section with the guidelines we found on how to stimulate second level reflection.

Norman's two kinds of cognition

The descriptions below are based on Norman's learning theory as described in *Things that make us smart* (1993). Norman distinguishes two kinds of cognition: two modes in which 'thinking takes place' (p.15). The experiential mode and the reflective mode.

The experiential mode is 'a state in which we perceive and react to the events around us, efficiently and effortlessly' (p.15). It refers to skills: automatic, reactive behaviour. Proper responses have to come instantly and effortlessly. Norman uses the example of a pilot: you don't want a pilot who needs to reflect on what to do when the plane has a problem. The pilot needs to react immediately and effortlessly with the proper response. Experiential thought is similar to a reflex: the experience simply reactivates relevant information that already exists in our memory.

In the experiential mode there is no room for new ideas and new concepts. These need the effort of reflection. 'The reflective mode is that of comparison and contrast of thought, of decision making. This is the mode that leads to new ideas, novel responses' (p.15). Reflective thought is not a simple reactivation of information already existing in our memory. It concerns the creation of new concepts by temporarily storing results and deduction from there. This process takes time and effort and can use support by material and people.

Norman's three kinds of learning

Norman distinguishes three kinds of learning:
- accretion: accumulating facts
- tuning: developing of skills
- restructuring: building new conceptual skills through reflection

Norman applies this theoretical framework only to individual learning, but the same learning phases can be applied to an interpersonal group learning process.

Accretion is how people add to their knowledge. In the EVOLVE case studies we observed several situations in which accretion took place. For instance a radiologist who wants to show scans on the document camera. She puts the scans on the camera and starts to describe them. However, she does not know that even though she is able to clearly see the scans on the camera, this does not necessarily have to be so on the monitor. Another participant explains this to her and tells her that she needs to check how the image shows on the monitor. This way facts are

added to the knowledge of the radiologist and perhaps to the knowledge of other participants. It is an example of accretion in groups.

Skills are developed through tuning. Developing skills is a slow process. Just knowing how to behave is not enough to perform this behaviour in a skilled way. Knowing that you need to check how images show on the monitor does not lead to an automatic check whenever you put a new image on the document camera. We noticed this in the above described situation where the same radiologist was requested to check the monitor a few minutes after this was first asked of her.

The third kind of learning, restructuring, is reflective while accretion and tuning are primarily experiential. When restructuring, people build new conceptual structures. According to Norman this is 'the hard part of learning' (p.30). This fits the observation in the EVOLVE case studies that restructuring occurs quite less than learning in the experiential mode. Building on the earlier example of the operation of the document camera, an example of restructuring would be a discussion about the use of scans in digital format rather than as hard copy. Discussing this option is not a simple activation of available knowledge. It is the combining of the knowledge that videoconferencing is digitally based and the knowledge that scans can be made digital as well. Deducing from there, the idea may rise that the document camera is a surplus device.

Our two levels of reflection

Based on Norman's theory, we distinguish two levels of reflection. We speak of reflection rather than learning, because according to (Tjosvold, 1991) "Experience itself does not teach; people learn from reflecting on their experience" (p. 189).

The first level of reflection we discern is is experiential and may lead to accretion and tuning. We combined accretion and tuning because we found it hard to distinguish between these levels when observing. Moments of first level reflection usually combined accumulation of facts and improvement of skills. The results of this first level reflection may be a better handling of the equipment. As a group process, this level of reflection is mainly a sum of individual behaviour: individual members of a group add to their knowledge or develop their skills. We rarely observed first level reflection as a true group process. An example is reflection on how to handle interruptions when there is a delay in audio transfer.

Our second level of reflection can be compared with Norman's restructuring: underlying concepts and values are being questioned. The result can be modified tasks, technology or social structures. Second level reflection is not just a sum of individual behaviour, but a true group process: a group as a whole discusses and perhaps changes objectives and underlying concepts. It is this second level of reflection that we hardly found in the EVOLVE case studies and therefore especially like to stimulate.

Reflection and organizational learning

The levels of reflection that we discern, resemble those mentioned in the organizational learning literature. (Senge, 1990) for instance discerns between participative and reflective openness. An important aspect that can be found in most theories about organizational learning is that in rapidly changing and complex environments it is important to explicitly discuss tacit assumptions and norms and values. Organizational learning can occur on two levels. These are depicted below.
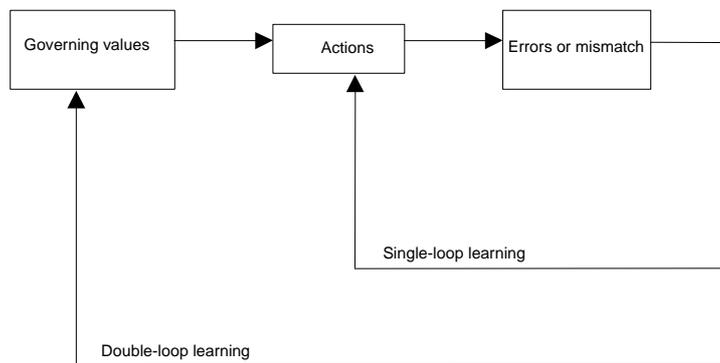

Figure 1. Single-, and double-loop learning.
       Note: From(Argyris, 1990)

What do others say about how to stimulate second level reflection?

Literature and former research yielded the following general guidelines (Argyris, 1982; Argyris, 1991; Karasti, 1997; Karasti, 1999; Mathiassen, 1998; Norman, 1993; Okamura, Fujimoto, Orlikowski, & Yates, 1995; Putnam, 1991; Putnam, 1996; Qureshi & Vogel, 2000):
1. Spontaneous reflection is unlikely:: facilitators, (or intervenors, or mediators) are required to stimulate reflection and hence changing usage;
2. Motivation is essential, but not sufficient;
3. Breaking out of a single interpretation is necessary;
4. Rational generalisation and emotional particularisation should complement each other.
5. Engagement is important for motivation, breaking out of a single interpretation and as counterpart of rational logic; this can be obtained by using rich material like video or narrative;
6. Concentration is crucial.

These guidelines formed the input for the feedback sessions as described below.

Design

As a setting we chose to return to the three hospitals of the EVOLVE case studies. At each hospital we had one session with respondents who participate in the teleconsultations. The number of respondents ranged from 5 through 10.

We combined two methods: group interview and questionnaire and embedded these in meetings which we referred to as feedback sessions towards the participants.

These sessions consisted of the following parts:
1. presentation of results
2. explanation of two levels of reflection
3. questionnaire
4. group discussion

Presentation of results

We started each session with the presentation of results from two earlier questionnaires comparing face-to-face meetings with videoconferencing: perceived quality, advantages, disadvantages. The goal of this presentation was twofold. First we expected it would attract participants and second we hoped it would initiate reflection. When presenting we tried to engage the participants by emphasizing that the results presented here reflected their opinion.

Explanation of two levels of reflection

A difficulty in both questionnaire and group interview concerned the terminology. We strived for using a common-or-garden synonym for 'reflection', since we considered this a too abstract term especially when splitting it into two levels. This was also a finding from a pre-test we held with the questionnaire. However, we were not able to find a synonym without giving up too much of the meaning. We therefore continued to use the term 'reflection'. For the two levels we found common names that covered the meaning close enough: reflection on skills, and reflection on changes.

We explained both levels of reflection by using video fragments with examples of both levels of reflection. These fragments were picked from the recordings made during observations at the concerning hospital. Besides an explaining function, these video fragments served the purpose of engaging people.

Questionnaire

The goal of the questionnaire was twofold. Besides collecting data it was meant as a stimulus to increase contributions in the following group interview.

We started the questionnaire with a few general questions: age, gender, function, years of videoconferencing experience. For both levels of reflection we asked questions about usefulness, actual and desired amount, and promoting and restricting factors. We further focused on the second level by asking respondents for examples of successful and unsuccessful or missing reflection, the proper person to stimulate reflection and his/her methods.

Group discussion
The goal of the group interview was to obtain more in-depth information from the respondents in addition to the questionnaire. We aimed at lively discussions in which respondents would 'spark off new ideas in each other' (Oppenheim, 1992, p.79). The group interview was non-directive. We used the questions from the questionnaire as a starting point, with a focus on the second level of reflection.

The above methods resulted in both quantitative and qualitative data. We analysed the former using statistical software and performed manual analysis of the latter through clustering the transcriptions of the group discussions and the open questions of the questionnaire.

Results

Below we present the results of the feedback sessions at all three cases. We did not differentiate between the three cases, but looked at the total of results. There were 21 participants: 20 male, 1 female; average age 48; 2 technicians, the rest doctors.

In the report below the results from discussions and questionnaires are combined and ordered by theme. The order does not correspond with the order in the discussion or the questionnaire

The amount of reflection

From our questionnaire we learned that 18 respondents (86%) experienced first level reflection before, while only 11 (52%) experienced second level reflection before. For both reflection levels 18 respondents (86%) found it useful. These findings are supported by the following table based on four questions concerning the actual and desired amount of reflection (answers on a 5 point Likert scale: 1=to a little extent, 5=to a large extent).

Table I. Means for actual and preferred reflection for first and second level reflection.

	mean for first level reflection	mean for second level reflection
To what extent does it take place?	2,5	1,9
To what extent do you think it should take place?	3,4	3,1

We conducted T-tests in order to test whether the differences between actual and experienced reflection differed significantly. From these T-tests it can be concluded that participants indicate that first level reflection as it is ($\underline{M}$=2.5) should be enlarged ($\underline{M}$=3.4, $\underline{t}$(20)=4.17, $\underline{p}$<.001). Participants also indicated that second level reflection as it is ($\underline{M}$=1.9) should be enlarged ($\underline{M}$=3.1, $\underline{t}$(19)=5.08, $\underline{p}$<.001). From the table it is also clear that participants indicate that second level reflection is least common ($\underline{M}$=1.9). These results repeat the findings of the EVOLVE research that the amount of reflection was quite low for all groups, and that second level reflection is least common. Furthermore, adding to the EVOLVE findings, these results show that the groups are aware of this gap between the extent to which reflection takes place (current situation), and the extent to which they think it should take place (preferred/desired situation). This confirms our notion that people are conscious of the need for second level reflection. However, there seem to be invisible forces that preserve the status quo, instead of realizing change by means of deliberate reflection. In the next sections, we will address possible causes for this lack of reflection, mentioned by participants.

Examples of reflection.

It turned out to be hard for respondents to think of concrete examples of second level reflection. In the questionnaire they were asked for two examples: a situation in which reflection lead to results and a situation in which reflection did not lead to results or did not take place although it was needed. Only four respondents (19%) came up with a relevant example. For instance: reflection on the fact that the meetings needed stronger chairing after the introduction of videoconferencing. Three respondents (14%) described a concrete situation of unsuccessful reflection or lack of it. Two of them referred to the situation that consultation from extra disciplines was still not realised. The fact that participants had a hard time finding examples of reflection, is another indication that participants do not engage in conscious reflection very often.

Discontent

Why reflect if everything is going well? This was the initial tenor of the discussions. However, during the discussions we learned that although the basics (audio, video, document camera) functioned, there remained some complaints and wishes for potential changes.

One of the technicians, for instance, complained about the number of microphones. He would like to extend the system with extra microphones but thought this was impossible. Others complained about the technology that should be simpler so that the consultants, who are not assisted by a technician, can operate it better themselves. Simpler technology was also mentioned in relation to more ad hoc use since the requirement of a technician could be dropped.

However, most complaints were not of technical nature, but concerned the non-executed plan to consult experts from more disciplines. The elimination of travelling opened up the option of consulting experts from more disciplines than the two that were consulted so far. The original idea was that consultants from extra disciplines, like a gynaecologist, could be recruited from the same hospital as the other consultants. In the questionnaire this wish was also mentioned by five respondents (24%) as a change that they would like to discuss with their colleagues. However, this change was never implemented, so dissatisfaction alone seemed not enough for effecting a change. In the next sections, we discuss possible causes for this, namely personal attitude, meeting climate, action orientedness of participants, and social entrainment.

Personal attitude

Personal attitude was named in the questionnaire as a restricting as well as a promoting factor. As a restricting factor it was mentioned for first level reflection by two respondents (10%): 'being quick to take offence,' and 'lack of interest'.

Attitude was a promoting factor for first level reflection according to three respondents (14%) and for second level reflection as indicated also by three respondents (14%). In the questionnaire respondents named words like 'involvement', 'seeing the need' for both levels. 'Being critical' was named only for first level, and 'enthusiasm' only for second level. In the discussion 'enthusiasm', and 'lack of involvement' were named in relation to second level reflection.

Meeting climate

An 'open climate' with an 'inviting atmosphere', less 'hurry', and a 'chairperson who pays attention to non-verbal reactions' would stimulate first level reflection according to 3 respondents (14%). Besides these remarks, meeting climate was not mentioned in the questionnaire nor in the discussions.

Action orientedness

Physicians in general are action oriented. They perform their assigned tasks and work towards agreed goals. It is difficult to motivate them to do anything that goes beyond this scope which was made clear by a surgeon: 'I want to treat patients in a way that suits me best. So, I don't intend to rise to that level every time.'

This cluster falls apart in three aspects: goal restriction, task restriction, and time pressure.

The first aspect is goal restriction. 'When the main goal is reached, in this case effective discussion of patients, you can wonder what the need is for reflection'. This excerpt from one of the discussions illustrates the general attitude of the participants. Participants don't see a need for reflection when the main goal is reached. When the goal is not reached and participants are discontent with the situation, this may stimulate first level reflection (two questionnaire respondents) and second level reflection (two other questionnaire respondents).

A second aspect is task restriction, in the discussion as well as the questionnaire only in the context of second level reflection. Regardless whether participants find this type of reflection useful or not: reflection and initiation of changes are not part of their task. One participant expressed it in the discussion as 'we're normally not tended to do that'. But mostly noticed during the discussions at all three sites was the passing of responsibilities to someone else. This could be the consulting party, the coordinating party, or a person within the own organisation like the technician. In the questionnaire three respondents (14%) named 'pre-occupation with own problem' as a restricting factor for second level reflection.

Closely related to task restriction is time pressure. Since reflection and initiation of changes is not part of someone's task, there is no time allocated for it. In the questionnaire five respondents (24%) mentioned this as a restricting factor for first level reflection against seven respondents (33%) for second level reflection. In the discussion, it was mentioned only once in relation to the need for structural integration (see below) of reflection: 'If you want to let it happen spontaneously, it will often not happen because of work pressure'.

Social entrainment

This concept, originally from McGrath and Kelly {McGrath & Kelly 1986 MCGRATH1986 /id /d} is used by van der Velden for his laboratory studies on the effects of mediated communication on group functioning (van der Velden, 1995). He operationalised it as: 'the extent to which the style of cooperation within a group is not influenced by the communication condition' (p.153). In other words: groups who developed a certain way of working are very reluctant to change this, even when the communication media change. The laboratory studies

of van der Velden did not confirm social entrainment. He suggests this may be due to a too weak influence of the communication condition on the group functioning (p.118). We assume this is an unavoidable side effect of laboratory studies. In real life the style of cooperation is given much more time to develop.

The discussions clearly indicated that this historical baggage weighs heavily. In our transcriptions we compared the segments coded as 'historical tradition' with segments coded as 'potential changes' and 'complaints'. As described above, the main complaint concerned the limited number of attending consultants. In the discussions it became apparent that the main obstruction to realise this idea was long-established consulting relations with other hospitals. We mentioned that these relations could be mediated by videoconferencing as well. This option was not considered before. However, participants agreed on its feasibility now that we mentioned it.

Who should stimulate reflection

In the questionnaire we posed the open question who would be the appropriate person(s) to stimulate second level reflection. The chairperson was named by 12 respondents (57%) and an external person by 6 (29%). This preference for the chairperson was not confirmed in the discussion. Participants agreed that they did not reflect spontaneously and that someone would need to facilitate it. The chairpersons themselves nor other participants suggested that this should be the chairperson. They suggested someone from outside the meeting, or outside the organisation. The participants mentioned quite a few times the institute who coordinates the oncological consultations.

Structural integration

Structural integration of reflection was named in the discussion as a promoting factor. For example: spend the last 5 minutes of each meeting on reflection. In the questionnaire three respondents (14%) named it as a way to stimulate second level reflection. One respondent mentioned that a reflective discussion should be held in a separate meeting, while another respondent stressed the informal character: reflection is stimulated by 'personal contact in between meetings'.

Engagement

Although not explicitly named by the respondents, we did find our effort to stimulate engagement during the feedback sessions useful. The presentation of questionnaire results and video fragments served this purpose. It led at two of the three sites to vivid discussions even before the questionnaire was handed out.

Conclusion

From the above research, it can be concluded that respondents experience a gap between the actual amount of reflection and the desired amount of reflection. This gap is the largest for second level reflection. Personal attitude and meeting climate are important factors in stimulating reflection, especially for first level reflection. We observed that respondents are 'socially entrained' in a situation that may be not optimal. Discontent with this situation does not lead to second level reflection and hence not to changes. Structural allocation of time is a first step in motivating to reflect on the second level. This aspect relates to the aspect of action orientedness. By building in reflection structurally, it becomes part of the task. Another conclusion that can be drawn from this research is that reflection does not occur spontaneously. Stimulation should come from either the chairperson or an external person and can be increased by means of engagement, and by making reflection a regular part of the job.

When combining these findings with the guidelines from literature and former research we conclude that an external person is needed to stimulate second level reflection. This person does not necessarily have to be a consultant, as long as it is a person with authority. In this case it could be someone from the external organization which coordinated the teleconsultations.

Such a person should (structurally) organise reflective sessions. The suggestion of several respondents to reserve the last five minutes of a teleconsultation for reflection, does not fit the guideline on concentration. After such a session, most people are in a hurry to go home, or finish some work. Their minds are on other things, so this will probably not lead to enhanced reflection. Therefore, we prefer the idea of separate sessions (like our feedback sessions) in which participants are not disturbed. This especially holds for the medical world in which physicians are continuously called by semaphones when on duty. Apart from these sessions, reflection should become part of the task, and take place during general meetings as well.

When organising such reflective sessions, engagement is an important aspect. This can be reached, like in our feedback sessions, by using video fragments of the current practice of the participants. If the goal of such a session is to let people reflect on alternative ways of working, these alternatives can, or should, be presented with rich material as well.

Another important issue is the link between reflection and action. The question is whether teams that do reflect, also adapt accordingly (Schippers et al., 2001). In the discussion people sometimes mentioned that they reflected on a certain action, without any following action, mostly because they failed to make concrete agreements about whom and when the action will be carried out. It can be

concluded that besides reflection, planning and action are also important (See also Schippers, 2001; Schippers et al., 2001).

Discussion

Although the current research revealed that people experience a gap between actual and preferred amount of reflection, we must conclude that the question of how to stimulate second level reflection is still largely unanswered. Literature and former research yielded only a few general guidelines and practitioners did not have clear-cut answers either.

However, this study added to the guidelines mentioned in the literature. It can be concluded that the topic of engaging people is promising. However, there may be a dilemma. If in a reflective session alternative ways of working are depicted with rich material, the sketched alternatives may have a steering influence on the reflection and possible change process. Second, someone needs to provide these richly depicted alternatives. These two consequences do not match with our original goal to stimulate a group to perform self-initiated unsteered reflection.

Our position for the workshop Learning Groups originates from this goal. With the other participants we like to discuss further ways of stimulating self-initiated unsteered second level reflection. We also hope to elaborate on the role engagement plays in this. Hopefully this will discussion will contribute to answering the question of how to fight the invisible forces that preserve the status quo and resist change.

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From Learning Organizations to Learning Students – What Can I Learn?

Position Paper for the ECSCW 2001 Workshop 3 on Learning Groups

by

Helge Kahler

FhG project managing agency "New Media in Education" for the German Ministry for Education and Research

helge.kahler@web.de

Past

For several years I have been working in the field of Computer Supported Cooperative Work (CSCW) and Human Computer Interaction (HCI). Over the years I participated in several projects, all of which were concerned with the issue of using computers to support professional work and involved application partners, i. e. organizations or groups which were observed how they worked or tried out software that was provided for them. The general questions relating to these application partners have always been *What does the work there really look like?* and *What can I derive for the design and introduction of computers to support office work?* Over the time I experienced many things that had been and still are described in literature: work life has many facets, you should not rely on organizational charts, the informal aspects of work often matter more than the formal aspects.

In my work I had the chance to observe "classical" organizations like government agencies (see e.g. Kahler 1996) and a very interesting "virtual" organization (see Rittenbruch et al. 1998, Lemken et al. 2000). We were able to describe what we found, but obviously there are no easy ways to change an organization - particularly in a way you want them to change. This led us to think about the evolving use of groupware as process perspective to understand and possibly later direct the use of groupware in organizations (see Rittenbruch et al. 1999).

In another strand of my work I considered the tailoring and particularly collaborative tailoring of software and groupware as one option to deal with organizational dynamism (Kahler 1995, Stiemerling et al. 1997, Kahler 2001). However, tailoring can always only be one measure of many possible to involve organizational members to promote and design change.

Present

Since April 2001 I am working for the Fraunhofer Gesellschaft (FhG) project managing agency "New Media in Education" servicing the German Ministry for Education and Research. Our task is to select, control, and network over 100 projects introducing New Media in University teaching. Each project involves at least two Universities which often develop content modules for student self-study via the Internet. The total funding sum over three years is about 225 Million Euro.

Future

To understand and foster New Media in University teaching it is important to understand how groups of students learn together particularly with the aid of New Media. Although there is a body of literature on group learning the research field does not seem to be very mature especially taking into account the usage of computers and Internet. Group learning of University students must also take into account the special learning situation between cooperation and competition, the fact that often learning aims at a single date of an exam and much more.

For the "New Media in Education" program I want to do a good job in understanding how in different projects groups of students learn together and identify critical success factors in order to spread them to the other projects. I hope and am confident that the workshop can provide me with valuable insights to help me in performing this task.

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Intervention Strategies in Groupware-mediated Interaction

Anders Mørch[1, 2], Ane Høyland[2], Karianne Omdahl[2], Hege-René Åsand[2]

[1]InterMedia, University of Oslo
[2]Department of Information Science, University of Bergen
{anders.morch, ane.hoiland, karianne.omdahl, hege.rene.asand}@ifi.uib.no

Abstract:
This paper takes as starting point our experiences with two ongoing projects: DoCTA NSS (Design and use of Collaborative Telelearning Artifacts – Natural Science Studios and From Chaos to Knowledge. Both projects are carried out by two multidisciplinary teams at the Universities of Oslo and Bergen in Norway. Through studying secondary school pupils and their use of information and communication technology (ICT) in the classroom, we address the following issues: 1) the teacher as facilitator, 2) software agents as facilitator, and 3) the distribution of collaboration support between computers and pupils.

Setting

Computational learning environments can be used in both distributed and co-located settings. When the learning environment is distributed (e.g. groupware), the learning place is not bound to a physical location, but takes place in a virtual space, e.g. a web-based discussion forum. This is in contrast to a co-located learning environment where the learning takes place in a setting where the collaborators have face-to-face contact, for example in a classroom. In the latter case the computer has an informative role instead of being the main communication and coordination medium. We address both settings in this position paper.

Project DoCTA-NSS studies 10th grade pupils as they use a groupware system (FLE2) to discuss ethical implications of biotechnology and genetics (e.g., the pros and cons of genetically modified food or cloning). We are interested in how human intervention (teachers, peers and researchers) can stimulate or hinder equal participation and trigger or prevent the development of abstract thinking skills. One role we envision for the computer is as (semi-) intelligent pedagogical agent system to guide these processes. Pedagogically, an agent can inhabit different roles, e.g. a helper or a guide, a facilitator, and/or a coordinator. In the "From Chaos to Knowledge" project we study how teachers behave as facilitators when ICT is used for educational purposes in the classroom. The aim is to give a foundation for an understanding of how the pupils can be helped to an improved process of learning.

Groupware

The groupware system we are using in DoCTA NSS project is FLE2 (Future Learning Environment 2), which is an open source system developed at the UIAH Media Lab in Helsinki (http://fle2.uiah.fi/). We have adapted FLE2 to our context, and we are currently extending it with computational support for pedagogical agents.

FLE2 is designed to support problem-based learning (PBL), in particular inquiry-based learning and a pedagogical model called knowledge building (http://fle2.uiah.fi/pedagogy.html). The groupware is implemented with categories that match the activities students need to carry out in order to "build knowledge" in interaction with each other. This is described in more detail in the next section.

Learning theories

The group is the main unit of analysis in groupware-mediated interaction and research addressing this concentrate on emergent, socially constructed, properties of interaction (both human-human-interaction and human-computer-interaction). Socially initiated activities require a process-oriented account of interaction, and the learning theories we employ for our analysis, reflect this view. With respect to the different interests of the present authors, the analytical techniques and tools vary depending on our unit of analysis.

Knowledge building

In analysis of the two settings we were influenced by the problem-based learning (PBL) philosophy, which Koshmann defines as "a collaborative, case-centered, and learner-directed method of instruction" (Koshmann, 1996, p. 96). Scardamalia and Bereiter (1996) introduced the concept of "knowledge building" referring to a scientific model of problem solving. One purpose of this was to designate a new pedagogical model, which would support the process of acquiring expertise, in particular, "progressive problem solving" as it applies to competence and understanding. Knowledge is seen not as a commodity to be acquired but linked to a process of competence development through inquiry-based interaction with others, and as such having primarily a social existence. By adapting this model into the traditional methods of education, a main goal is to get the pupils involved in the construction of a public and social understanding.

Teaching pupils to construct public and social understanding is accomplished by peer-to-peer interaction triggered by problems of general interest (e.g. ethical implications of biotechnology), mediated by communication-based groupware technology, and supplemented by external resources (e.g., newspaper articles) and facilitated by teachers and pedagogical agents. The process aspect of competence development refers to a progressive type of problem solving, rarely supported by contemporary teaching theories. Figure 1 illustrates our view of the knowledge building process, based on this model.
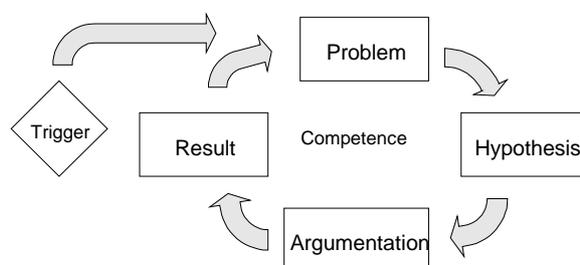

Figure 1. Progressive knowledge building

When presented with a trigger, e.g. a video or newspaper excerpt, the pupils will start to think and identify problems emerging from the trigger. Further elicitation may generate hypotheses and working theories, i.e. alternative answers and tentative solutions to the problem, and this may again provoke a need for further exploration of the problem domain. Material may be gathered from secondary sources enabling the pupils to convincingly argue for or against their proposed hypotheses.

Searching for deepening argumentative knowledge leads to temporary results, which again trigger a new iteration in this process of competence development. The iterative process of reflection and gradual refinement may eventually lead to breakthrough development (the great "aha's"), bringing the student to new stages in the knowledge building process.

Activity theory
Activity theory is a philosophical and cross-disciplinary framework for studying different forms of human practices and developmental processes. The unit of analysis is the activity itself, and the theory stresses real activities in real situations (Kuutti, 1996). This is a dialectical approach where the contradiction between an activity and its situation (including other activity systems) is what motivates and leads to transformation. A contradiction is a relation that at the same time encompasses an interdependency and a conflict (Engeström, 1987). In our analysis we use Bødker's (1996) concepts of *breakdown* and *focus shifts* to identify contradictions. A breakdown can be seen as a way to shift the focus from one activity system to another, or from an activity to its elementary parts (subjects, artefacts, goals, etc.) or to its elementary processes (actions and operations).

Zone of Proximal Development
Vygotsky (1978) introduced the concept of "Zone of Proximal Development" (ZPD), which is one of the founding concepts of socio-cultural psychology. A brief explanation of this complex process is that humans learn through interaction with each others, in particular one's more capable peers, and that this is mediated by tools, both linguistic (e.g. language) and material (e.g. computer applications). This is illustrated in Figure 2.
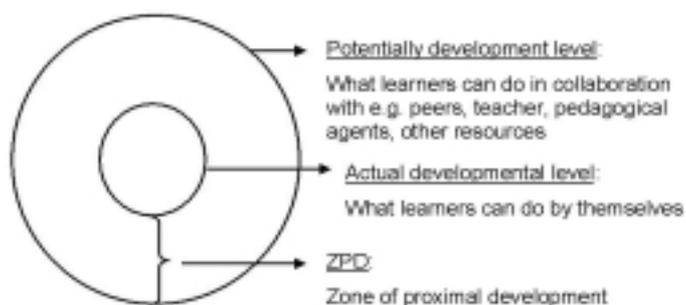

Figure 2. Zone of Proximal Development

We use this concept to find out how the processes leading up to new knowledge is facilitated. In particular who assists the pupils and how is this facilitation realized. It is

for example interesting to investigate to what extent teachers, peers (i.e., fellow pupils), pedagogical agents and resources can form an extension of the pupils' knowledge.

Intervention and breakdown

Our contribution to the workshop will be to extract data from our case studies with the perspective of proposing answers to the research question raised by the organizers in the call for participation, in particular:

- How can the reflective restructuring be stimulated in groups by social and technical means?

From this question we can flesh out the following two sub-issues:
- How can human facilitators stimulate focus shifts in the pupils' interaction mediated by a computer system?
- How can software agents create breakdowns in groupware-mediated interaction?

We will address these questions in more detail upon acceptance.

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Understanding learning groups

Ingrid Mulder

Telematica Instituut
P.O. Box 589
7500 AN Enschede
The Netherlands

Phone: +31 53 - 485 0 499
Fax: +31 53 - 485 0 400

ingrid.mulder@telin.nl

Understanding learning groups

Without shared understanding, hardly any group learning takes place. Though much has been written about the essence of shared understanding, less is known about how we can assess the process of reaching shared understanding. Therefore, we focus on ways of assessing shared understanding. We describe our conceptual framework on shared understanding and group learning making the distinction between the process of reaching shared understanding, and the resulting amount of shared understanding. The conceptual ideas put forward here leads to a coding scheme for observing the processes of shared understanding and to the definition of product measures, among others a scale to assess perceived shared understanding. This contribution has been based on earlier work (Mulder, Swaak & Kessels, submitted). However, a new discussion is included. The purpose of this discussion is to shape our position in and motivation to participate in the workshop '*learning groups*'.

A conceptual model on shared understanding and group learning

Shared understanding refers to mutual knowledge, mutual beliefs, and mutual assumptions (Clark & Brennan, 1991). We view the process of reaching shared understanding as an important type of group learning. The outcome of these group processes is a certain amount of shared understanding: in other words, the overlap of understanding and concepts among group members. When progress is made in the group, understanding changes, and therefore group members need to update their shared understanding moment-by-moment. When we refer to the process of reaching shared understanding, we implicitly include the updating of shared understanding. Figure 1 represents our theoretical notions on reaching shared understanding. We view that conceptual learning, the use of feedback and expressions of motivation are part of the process of reaching and updating shared understanding. It should be noted that three perspectives on group learning are included in this model: a learning and instruction perspective by conceptual learning, a point of view of communication by the use of feedback, and third, a social learning perspective by the expression of motivation.
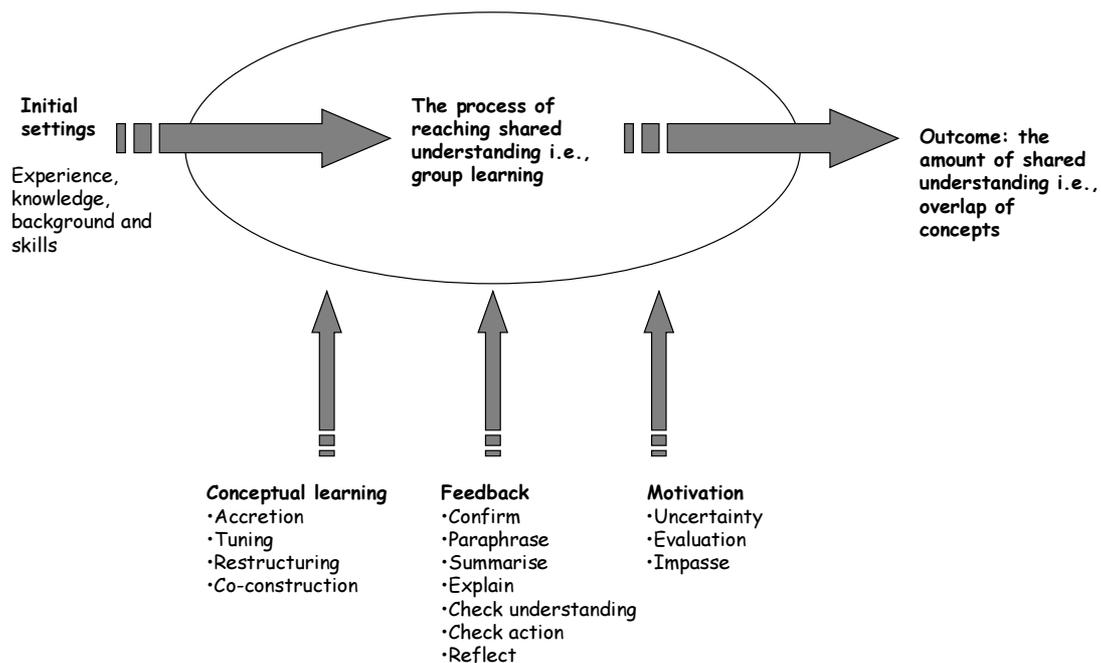

Figure 1: Conceptual framework on reaching shared understanding

In the following we explain how conceptual learning, feedback, and motivation make up the group learning process for reaching shared understanding.

Conceptual learning

By conceptual learning we refer to the exchange of facts and concepts, reflection on them, and finetuning. Norman (1993) distinguished various modes of learning, which forms the basis of our assessment of shared understanding. Whereas Norman emphasises skills, we place more emphasis on concepts and understanding. We adapt the modes distinguished by Norman, and redefine as follows. When concepts and facts are added, we refer to his term *accretion*. We use *tuning* for the fine-tuning of these concepts and facts: i.e., when utterances involve more specifics, more detail, or when utterances define more boundaries, or make the scope explicit. We use *restructuring* when new relations between concepts or a new conceptual framework are being created. Only after *restructuring*, can understanding be updated. As our goal is to analyse continuously updated shared understanding among the group members –focusing on group learning instead of individual learning– we add *co-construction* (of knowledge) (Van der Meij, 2000) to Norman's troika. The main difference between the latter two modes of conceptual learning is that restructuring involves individual reflection, whereas co-construction concerns the restructuring of the whole group.

Feedback

Feedback mechanisms are used to structure the communication process, and also to encourage reflection. The use of feedback contributes to reaching shared understanding because listeners understand better when more feedback is provided (Krauss & Fussell, 1991; Schober & Clark, 1989). Moreover, some researchers view feedback as a specific type of learning (Argyris & Schön, 1978). Based on the functions of feedback in communication (Gramsbergen & Van der Molen, 1992), and our specific wish to measure understanding, we define the following distinct feedback mechanisms: confirm, paraphrase, summarise, explain, reflect, check understanding, and check action. We added the latter two variables 'check understanding' and 'check action', to the feedback mechanisms defined by Gramsbergen and Van der Molen.

Motivation

Learning is also affected by motivation (Bandura, 1986). Therefore, motivation has been added to include evaluative expressions on the usefulness of acquired information. More specifically, we refer to the expression of certainty and uncertainty, and subjective expressions of the 'value' of the situation. We distinguish the expression of certainty and uncertainty, impasse, and evaluation.

To sum up, conceptual learning, feedback, and motivation are complementary and closely related. They have distinct purposes, though conceptual learning is more associated with cognition, whereas motivation involves the motivational and emotional part of learning. Snow (1989) labels this distinction, referring to the cognitive and conative structures in learning. Finally, feedback focuses on the mechanisms that structure communication.

Assessing shared understanding and group learning

The conceptual ideas put forward in the previous section leads to a coding scheme for observing the processes of shared understanding and to the definition of product measures: a scale to assess perceived shared understanding.

Coding scheme

The purpose of a coding scheme is to acquire some objective measures from the rich and qualitative transcriptions. This coding scheme is based on our conceptual ideas, in which four main categories were distinguished: task/domain (content), social interaction (relation), planning of activities (procedure), and technology. As reaching understanding relates to use of feedback and to expression of motivation, certainty and uncertainty, feedback and motivation were included. In order to acquire a complete scheme, a two-step procedure with segmentation preceding categorisation was followed (Van der Meij, 2000). First the transcripts were divided in segments (utterances). Then, each segment was categorised on a certain dimension. Table 1 displays the categories and dimensions used in the coding scheme.

Table 1: Categories and dimensions used in the coding scheme

Linguistic expression	Kind of interaction	Conceptual learning	Feedback	Motivation
Assertion Question Reaction	Task/domain Social Procedure Technology	Accretion Tuning Restructuring Co-construction	Confirm Paraphrase Summarise Explain Check understanding Check action Reflect	Uncertainty Evaluation Impasse

First, all segments were coded on *linguistic expression*, whether they contained an assertion, a question, or a reaction. Assertions are statements of facts, principles, choices etc. whose main intent is to inform the other group members. Questions are explicit requests for information. Reactions are responses including answers to questions and responses to assertions. In email communication this distinction is clear; in transcripts of videoconferencing meetings it is not always apparent.

Then, each segment was coded according to the type of interaction, whether it dealt with task/domain, social interaction, procedure or technology. Utterances that involved the task or the project description were coded as task/domain. Utterances that did not involve the task, but were more personal and cultural were coded as social interaction. Under procedure we included planning of a next meeting and structuring the current meeting. Finally, utterances related to technology use or media choices were placed in the category technology. It might be confusing how to code specific task-related technology, for instance AutoCAD. We coded this kind of technology as task/domain, because even in face-to-face project meetings team members would have used this technology.

In addition, each segment was coded on a *specific* category-related dimension, a type of *conceptual learning*, the use of *feedback*, and expression of *motivation*. Conceptual learning was used when the content of the information was being manipulated. Of course, we were aware that we could only code explicit learning. With respect to conceptual learning we were interested if an utterance involved accretion, tuning, restructuring, or co-construction. We coded these learning types as follows:
- *Accretion*: adding or repeating concepts and facts;
- *Tuning*: fine-tuning of concepts (i.e., making them more specific, adding detail, adding boundaries or making the scope more explicit);
- *Restructuring*: providing new relations between concepts or a new conceptual framework (i.e., reflecting on the individual level;
- *Co-construction*: restructuring of the whole group.

To analyse the use of feedback, we used the following categories: confirm, paraphrase, summarise, explain, check understanding, check action, and reflect. In our manual (Mulder, 2000) we used the following definitions:
- *Confirm*: Reaction that can be indicated as an agreement. The understanding is shared;
- *Paraphrase*: Summarising using one's own words. This is also a form of reflection;
- *Summarise*: One of the group members summarises what has been told before;
- *Explain*: Reaction on other utterances, which provides new information or increases the understanding;
- *Check understanding*: Checking self-understanding or another group member's understanding of a previous utterance;
- *Check action*: Checking whether an action has been understood by another group member;
- *Reflect*: This code represents a feedback mode to indicate meta-communication, which is not necessary procedure or technology related. This code should be used as a kind of evaluation and a feedback mode.
- *Other*: We added an extra category in case we did not capture all feedback categories. In other words, if an utterance involved feedback, though it was difficult to subscribe it to one of the categories mentioned above, on should code this utterance as other.

Finally, in order to indicate motivation, we distinguished evaluation, uncertainty, and impasse. *Evaluation* was chosen when there was an opinion stated, or when something was evaluated, *uncertainty* was related to the expression of confusion or doubt, and an *impasse* was indicated when the group expressed they did not know how to go any further.

In order to calculate the reliability of our coding scheme a random sample of 128 segments (of every other meeting) had been coded independently by two experienced raters who have been instructed by a manual (Mulder, 2000). These 128 segments were coded for all categories. This represented 5% of the segments of the current study (i.e., 2531 segments). To calculate the inter-rater reliability, the equality of coding by the two raters, we used coefficient kappa. This coefficient indicates the amount of agreement corrected for the agreement expected by chance. The overall average value of the inter-rater reliability was .839, which is considered 'almost perfect' by Landis and Koch (1977:265).

The product of shared understanding

We added an *instrument* (self-scoring) (Mulder, 1999) *to measure the perception of shared understanding* (both process and product). With this instrument we measured how group members perceived their understanding concerning content, procedure and relation aspects. The students indicated their understanding on six-point and seven-point rating scales (Likert) which refer respectively to their understanding of the several aspects and how this understanding has evolved. An example of the rating scale is shown in the box below.

Box 1: Instrument for measuring the perception of understanding of the content

How well do you understand the definition and requirements of the problem?
Very badly (1)------(2)------(3)------(4)------(5)------(6) Completely well

To what extent has your understanding of the group's definition and requirements of the problem changed since the previous meeting?
Understanding has decreased a lot (1)------(2)------(3)------(4)------(5)------(6)------(7) Understanding has increased a lot
Nothing has changed

To what extent does your group holds a shared interpretation/ understanding of the definition and requirements of the problem?
No shared understanding at all (1)------(2)------(3)------(4)------(5)------(6) Completely shared understanding

Since the previous meeting, to what extent has a common understanding of the definition and requirements of the problem emerged in your group?
There is less common understanding (1)-----(2)-----(3)-----(4)-----(5)-----(6)-----(7) there is more common understanding
Nothing has changed

Main findings and discussion

We applied our conceptual ideas using the coding scheme and the rating scales on perceived shared understanding in an empirical study (Mulder & Swaak, 2000; Mulder, Swaak & Kessels, submitted). Some findings from the empirical study were:
- Task-related utterances predominate;
- Little social interaction takes place;
- Little learning takes place, especially hardly any learning on technology;
- Much time is devoted to planning of activities;
- Overall, little reflection takes place in technology-mediated teams.

Thus, one major conclusion is that it was difficult to find reflective utterances in the protocols. An explanation for not finding reflective utterances is that little reflective activity took place. It may be more difficult to express this kind of utterances in technology-mediated interaction. If this is true the importance of assessing group learning and shared understanding increases, and it emphasises the changing role of support in problem-based learning. By support we refer not only to technology support, but also to social support, such as the role of a tutor.

Another possible explanation seems to be that it is indeed difficult to assess reflectivity. Particularly, hardly any co-construction was found in the transcripts. As co-construction involved restructuring by all group members, it may indicate that this learning mode needs to be coded across segments.

In the workshop we would like to discuss the assessment of (collaborative) reflection, and we especially hope to get ideas, insights, and answers to our research dilemma, as pointed out here. Some issues we are struggling with at the moment are:
- Do we need to exclude *co-construction* and *reflect* from the coding scheme?
- Do we need to assess the conceptual learning mode *co-construction* on another (meta-)level than accretion, tuning and restructuring (e.g., across segments)?

- Do we need to assess the feedback mode *reflect* on another (meta-)level than the other feedback modes.
- Are *co-construction* (conceptual learning) and *reflect* (feedback) more influenced by other categories, respectively feedback and motivation, and conceptual learning and motivation than the other dimensions in the coding scheme.

To sum up, we would like to contribute to the workshop with findings of our own research, and hope to get a reflective discussion on this important topic.

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Learning Contexts in Participative Design

Uta Pankoke-Babatz
GMD-FIT
Institute for Applied Information Technology
Schloß Birlinghoven
D-53754 Sankt Augustin, Germany
uta.pankoke@gmd.de

Introduction

Designing usable groupware systems is a very difficult task. Knowledge and people from two different cultures are meeting in the design process. A major problem is to design a mutual learning process between users and designers.

In this contribution the differences and particularities of designers and users are looked at. Two cases of establishing learning situations are introduced where designers may learn about users.

Learning contexts

Users and designers act in different contexts and have different aims. The groupware system under development also plays different roles in both communities.

To the users, the groupware system is a means to perform one's regular work. Users become aware of the groupware system usually only in case of failures. The context in which they see the groupware system is their individual work and tasks. Even worse, depending on their role in a collaboration context users may understand the groupware system differently and have different and possibly contradictory needs.

In contrast, to the designers the groupware system is "their baby" and is in the centre of their work and their interest. They understand the groupware system in the context of technical innovation, system design, architecture etc. The elegance, the technical innovation are important to them.

This became e.g. evident in the POLITeam project (Pankoke-Babatz &Syri 1997). While the users often needed detailed modifications of basic functions, the designers were not interested in doing this, but instead, in developing new features.

Learning needs

When a new groupware system or system feature is introduced at the users' site, users have to learn about the groupware system and its features. They have to learn, how to use it and how to adapt their work habits to the groupware system in order to benefit from it.

In case the users have the opportunity to influence the design process–be it as a customer or as a participant in a participative design process–they may articulate their needs. In many cases this is not a suitable approach, since users may not know enough about the technical potential and what is even worse, they may not even be aware of their work habits and are thus unable to articulate them. Most of their knowledge about their work patterns is tacit and they act intuitively according to the given situations and tasks (Kyng 1994).

Articulation of needs thus requires from the users in the first place to become conscious of their individual work habits, i.e. to reflect and learn about them. They have to become conscious of their own motivation, learn how they develop plans to reach a goal and perform a task, how they perform operations and how they react on environmental conditions etc.

Usually much of the expertise in everyday work is acquired through learning by doing, by observing others and other intuitive learning processes. It has become skills, rather than knowledge. In order to teach other people how to perform this job or to articulate needs for technical support, the rationales behind the skills and the work habits must be made explicit.

To summarize participation in design processes requires users to learn about the groupware system but also about their own work practice.

Learning about user needs

In the past, the analysis of users' work situations and patterns was often delegated to social scientists or to ethnographers who should derive the user needs. But from observeration, the rationale behind the individual operations could not be learned. Thus Bardram's finding that this approach has not led to the development of user accepted groupware systems is not surprising (Bardram 1997). Among others, a reason for this failure could be that no mutual context could be established between designers and users. Iinstead, the interaction between users and designers became more indirect as they are mediated by ethnographers..

Looking at the designers in a participative design process, they have to learn about technical conditions, programming environments, coming up technical innovation etc. at the one hand and about user needs on the other hand. The latter aspect requires to develop an understanding the users' work contexts and work situations. Greenbaum et al (Greenbaum &Kyng 1991; Kyng 1994) have developed a concept for design at work and for establishing a mutual learning process between users and designers. Bowers (Bowers 1994) proposed to raise user needs by means of an existing groupware system. In POLITeam we combined both approaches and raised user needs for system improvements during the use of the groupware system at real work. User advocates–being members of the design team–supported the learning and using of the groupware system at the user site. The user's process of learning the groupware system use thus became a process of user advocates learning about user needs and technical improvements required (Pankoke-Babatz et al. 1997; Mambrey et al. 1998). The user advocates participated in the design discussions and took the role of the users. The cases observed in user's work situations were used as cases to teach the other designers about user needes. This procedure enabled an incremental improvement process for the groupware system. But for the development of radically new features it is not sufficient.

Designer's learning user needs through role switching

To my experience, the designers have the potential to become the innovative force in a participative design process. But to fulfil this role they need to improve their understanding of user perspectives.
For this purpose, we set up a new kind of process in the TOWER project. TOWER is an EU project with four development partners and two user sites. The aim of this project is to develop a collaborative environment based on shared file systems or shared workspaces which provides awareness about mutual activities. For the provision of awareness information it is necessary to learn about how people achieve awareness in everyday co-located collaboration and what kind of information is needed to support awareness in non-collocated teams.
To this end we have put the designers themselves into the roles of users.
We observed and documented the work process in the TOWER team throughout the project. We could observe to role of different media–shared workspaces, email, chat, audio-conferences, and the TOWER world itself–in the different team phases. We could see how designers adapt the features and learn using it in collaboration. The differing needs in the various team phases and the mutual impact of technical features and social processes could be observed.
This procedure also enabled the designer to experience the tools under development from a user's perspective. If a feature is not used in the way expected, this gives clear evidence, that improvement is needed.
This procedure enables the designers to experience their own product from a very different perspective. The groupware system is now experienced in the work context and may appear quite differently as before. This experience may help them to better acknowledge the users' perspective.

Learning from Tower

In the course of the first year of TOWER work we could differentiate four different phases of work. Beginning with the phase of team building, followed by a discussion phase of major project design issues, followed by the phase of producing the deliverables and groupware system specifications and ending with a phase of joint programming. In the phases of getting together, awareness about the people was mainly requested. In the phase of producing the specifications, the progress of work could be observed by the activities in the shared workspace. In the programming phase not much awareness about the mutual activities was requested, people did not want to be disturbed. But immediate reaction was requested in case of problems occurred in a joint program. Thus each phase had its own interaction patterns, rhythms and relevant media. In each of the phases, the usage and relevance of tools changed and other needs for awareness support appeared. This raises the need to have some situative adaptation of the awareness supplied.
During the process of getting acquainted to new media, the modes of using the tools changed. This became evident when audio-meetings changed from a means for informal get-togethers to a medium for formal project meetings and task negotiation and assignments.

The role of models

Understanding user needs and work processes does not only require a detailed analysis of user habits, operations and actions. In addition the inner logics of the user's world have to be understood. To this end, the observations made have to be contextualised into theoretical models about work and cooperation. In my experience the following models turned out to be suitable. Leont'ew's Activity Model helps to understand the relationship between activities and motives, actions and goals and operations and environmental conditions (Leont'ew 1977; Kuuti &Arvonen 1992). Using this model, the understanding of motives behind the observed user behaviour and behind the narrative stories about users' work tasks can be improved. Barker's Behaviour Setting Theory shifts the attention from inner individual motives and from the internals of collaborative processes, to the external physical environmental conditions and their impact on the behaviour and the collaboration of its inhabitants

(Barker 1968; Barreau &Nardi 1995). This model is in particular suitable since the groupware system will change environmental conditions. The understanding of the synomorphy between environment and standing pattern of behaviour is helpful to improve the designers' understanding of the impact of the groupware system. Other models for understanding the role of human communication, of rhythm and time in human interaction etc. may also be useful.

If observations and requirements are looked at with these kinds of social-psychological models in mind one may more easily understand the needs and one may also derive additional possibilities for technical support which have not been disclosed so far (Pankoke-Babatz 2000).

Résumé

It was interesting to observe that even for the designers, essential differences occurred between their expectations of media use and the actual usage. This confirms, that the usability of a groupware feature can only be finally evaluated through practical use.

However, the proposed usage of a groupware system in the design team does not replace its evaluation in the users work processes, but it is a valuable method for pre-tests and may reduce the amount of user involvement needed and in particular it protects the users from experimenting with unsuitable solutions.

For the development of innovative features the findings about users work practices should be put in the context of appropriate social-psychological models about human behaviour and interaction. These should be used as theoretical structures for learning more about user's work and needs. This contextualisation may help to discover additional findings about the work process and to better predict the impacts of coming up technical features.

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Notes to the workshop:

Within the framework of the POLITeam framework the author has acted as a user advocate and moderated the mutual learning process between designers and users. In the TOWER process she has observed and documented the team development process. She is also responsible for the user requirement analysis in this project.
During the workshop it will be interesting to introduce and discuss the two proposed learning settings.

Requirements and learning groups:
An evolutionary perspective on Groupware implementation

Dulce T. Pumareja
Information Systems Group, Department of Computer Science
University of Twente, The Netherlands
{pumareja@cs.utwente.nl}

Background

Groupware is a slippery technology. The absence of rules, standards and boundaries opens the conceptual doorway into a build-up of a spectrum of application systems with various and overlapping sets of use functionality that lead to inconsistent implementation outcomes. It is left to the creativity and imagination of the organizations to give form, identity and meaning to the groupware system they put in place.

Ciborra [5] describes Groupware as a technology that "drifts" when put into use. In empirical studies of Groupware implementation in organizations [1][5][6][12] it was observed that organizations appropriate groupware systems in different ways. Continued use of groupware system results into an evolving and contextual use of the system, which is different from what the organization has intended to do at the start and what the spirit [7] of the technology suggests.

From a systems engineering perspective, the emerging properties of a system effected by the continuing use of the system by users is a by-product of changing and evolving user requirements. System maintenance is the corresponding system development process that is made up of activities that deal with adapting and improving the system to address inherently changing user needs and desires.

An evolutionary perspective on groupware implementation

Adaptation and changes to a software system's functionality is a consequence of a learning process along with other factors such as responding to changes in legislation, business practice or changes in the hardware and software operating environment. In cases of continuously and successfully evolving systems thus far, such as those from Microsoft, Cusumano & Selby [4] noted that at least 30% of feature changes directly result from learning during user and system interaction.

As a software engineering product, groupware is designed and developed from a set of requirements elicited from the target users of the system. That these requirements shift and evolve due to changing user needs during the implementation process is an inherent issue in any system implementation. Requirements can be regarded in a dualistic sense : as an *input* to design in systems engineering and a distilled *output* of a learning process in the user-system interaction. Evolving requirements in system implementation is a continuing cycle of eliciting learning process outputs and transforming such as inputs to software design.

We therefore regard system implementation or for this matter groupware implementation as an evolutionary process. This notion brings us the following relevant questions for further investigation:

- *How do user requirements change in an evolutionary process*? In the case of learning groups, how does the on-going learning affect the group's requirements?

- *How should a system adapt to evolving requirements?* According to Lehman et al [8], for a system to remain in satisfactory use for a certain length of time requires that it be continuously adapted and enhanced. The more relevant methodological issue is how to consistently match the requirements of learning groups to that of software design?

While the emphasis of the research project I am working on is more on the system that groups of people use to support the performance or accomplishment of their tasks, we do need an understanding of the learning processes that take place in system implementation. A deeper appreciation of these processes provide us with clues as to the '*requirements*' on how to design the kind of scaffolding and system modeling necessary to support a continuing use and system evolution process. To this effect, there are two concepts we would like to expound further on, namely affordances and constructivism.

- Affordances are opportunities for use that result from the properties and characteristics of a certain technology or system. According to Norman [9][10][11], the affordances of an object refers to its possible functions with an emphasis on the perceptual aspect. A chair for example offers support and therefore affords sitting. In terms of software applications, a spreadsheet application allows for a quite substantial amount data computation and manipulation and therefore affords the development of rudimentary database management system.

  For groupware systems, it is relevant to ask what are the affordances that can be derived from the manner in which groups of people use the same system together? What are their perceived use of the system? How are they currently using the system in relation to their tasks?

- Constructivism is a well-articulated meta theory applied in learning and most especially in instructional design. The theme of constructivist learning is that learning is an active process in which learners construct new ideas or concepts based on what they already know, i.e. current and past knowledge. The learner selects and transforms information, constructs hypotheses and makes decisions relying on a cognitive structure that is already in place. Cognitive structures such as schema or mental models provide meaning and organizations to experiences and allow the individual to go beyond the information given [2][3].

  In the context of groupware implementation, we can say that users construct their own use model of the system based on their previous experiences, past and current knowledge of their tasks and work environment. The shared use of the system allow for a process of mutual co-construction of meaning and use of the system in a cooperative way. For a social technology such as groupware, the intersection of the individually constructed conceptual models comprise the social space defining the purpose of the system.

Interest in the Workshop

Our interest in the workshop is motivated by the desire to exchange ideas and cooperate with other researchers who are doing similar research. For the past 6 months, I have been working on conceptualizing the theoretical and research framework on the topic of evolutionary implementation of groupware in organizations, one of the research themes within the *Business Information Technology Engineering 2000 and Beyond* (BITE 2000) project. This project is a joint cooperation from the department of Computer Science and Technology & Management of the University of Twente.

The orientation with which we would like to approach this research topic is from a system engineering perspective, specifically focusing on requirements. Understanding the group learning processes that take places during system implementation will help us anticipate the requirements for groupware systems and to model their trajectory of change.

I am looking forward to a fruitful mutual exchange of ideas through this workshop.

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Learning Groups and Groupware: The importance of the context

Anabela Sarmento

ISCAP / IPP – Rua Dr. Jaime Lopes de Amorim

4465-111 S. Mamede Infesta

Portugal

asarment@mail.telepac.pt

In scenery of rapid and great changes, organisations are adopting new models of social organisation. These models are oriented to work teams, are more participative and have a hierarchical structure more flattened and flexible in order to become more competitive and dynamic [Khoshafian, 1995]. Organisations also become conscious of the importance of learning needs and knowledge management.

The adoption of these models of work and the consciousness of knowledge importance and learning go with the adoption of Information Systems and Technologies that will allow to deal with the necessary information, with quality and accuracy.

Among all the solutions offered by markets, we point out GroupWare / CSCW and in particular Workflow Systems. These recent technologies present themselves like a solution able to improve efficiency and management of organisational processes. They make at one's disposal communication tools allowing collaboration, information share, knowledge and coordination of work. They also support organisational processes and work teams, providing tools to facilitate informal communication, automation and reduction of time of task accomplishment, allowing the realisation of work in a more efficient, effective and creative manner [Khoshafian, 1995]; [Jablonski, 1996].

As these technologies are recent (for instance, the first reference to Workflow Systems appeared in 1992[1]), there are still lots of questions to be answered. One of these questions that is still unanswered is precisely the impact of Workflow Systems in organisations, that is, what kind of changes will they enact and where. Simultaneously, it is not yet clear why and how these changes happen. Nevertheless, we are conscious

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[1] see [Medina-Mora, Winograd et al., 1992]

that the adoption of any technology in an organisation always means changes. Being an organisation an open and dynamic system, we easily understand that any change in any of its parts means changes in all the remaining ones, including its environment [Bertalanffy, 1973]. The same technology can also have different impacts in different organisations.

In my individual project of PhD, I developed a framework to analyse the impact of workflow systems in organisations. This framework also tries to explain why and how changes happen, that is why the impact of the same technology might differ from organisation to organisation [Sarmento and Machado, 2000]; [Sarmento and Machado, 2000]. This framework takes into consideration the organisations, its characteristics and environment, as well as the characteristics of workflow systems. It also considers change as a process, rather than an event, enabling anticipated, opportunistic and emergent changes, adopting the ideas conveyed by Orlikowski and Hofman [Orlikowski and Hofman, 1997].

In order to see the validity of such framework, it was applied to two Portuguese organisations [Sarmento and Machado, 2001]. The results show that the framework is a valuable tool to identify either the domains of change as well as the organisational factors that influenced the results obtained.

In parallel with my individual project, I co-founded a group, with five other colleagues, in November 1999, named MOISIG (Management, Organisations and Information Systems Interest Group) [Batista, Sarmento et al., 2001]. As the members of the group live in different regions of Portugal, we usually communicate and interact by e-mail and Internet. From time to time we also meet in person to accomplish special tasks and fulfil some socialisation needs. During this year and half of existence of the group, we feel that we have grown up together and learned in a collaborative way.

Taking into considerations either my individual project or my experience with MOISIG, I feel that my participation in this workshop might be very valuable, not only to allow me to share what I have learned (presenting the framework of analysis and / or the case studies and / or the case of MOISIG) but also to develop my knowledge with the experience of the others.

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How Groups Learn to Use Digital Artifacts

Gerry Stahl

Fraunhofer Institute for Applied Information Technology FIT, Germany
and University of Colorado, USA
Gerry.Stahl@fit.fraunhofer.de
http://orgwis.gmd.de/~gerry

INTEREST

My interest in this theme was sparked by my need as a groupware developer to comprehend the cognitive and social issues involved in adoption of software artifacts that I designed. In searching for a theoretical framework to apply here, I was led to the notion of **the artifact** in activity theory. Increasingly during the past year or two I have become interested in the philosophical question of how people learn to understand and use artifacts. This is a generalization from issues of groupware adoption. In the case of groupware, the term "artifact" is referred specifically to digital media and other software applications, while the issue of people learning becomes one of groups effectively adopting.

THEORY

I am interested in several theoretical themes that I think provide a framework for thinking about how groups learn to use digital artifacts like groupware applications:

1. In the writings of Vygotsky (Vygotsky, 1930/1978), for instance, the thoughts and actions of individuals and groups are viewed as mediated by linguistic and physical artifacts. In particular, learning is mediated by artifacts. I would propose that it is theoretically productive to conceptualize groupware as digital **artifacts**. As such, groupware mediates the work and understanding and learning of groups – it acts as a medium of interaction. (Stahl, 2002)

2. To make the discussion of "learning processes in the evolutionary implementation of groupware" more concrete, I would suggest using the term "**collaborative knowledge building**" (Bereiter, 2002) in place of "learning." The goal of the group is to build up knowledge about the groupware artifact by developing new theories, principles and terminology – some of which may be inscribed in written texts – that is, new linguistic and physical "knowledge artifacts." These knowledge artifacts are constructed largely through group activities of critical reflection. (Stahl, 2000)

3. It is often helpful to analyze the process of collaborative knowledge building as an **intertwining of personal and group perspectives** (Boland & Tenkasi, 1995). Although individual contributions and interpretations play an undeniable role in the knowledge building, the overall accomplishment of constructing meaning takes place on the level of analysis of the group. (Stahl & Herrmann, 1999)

4. One can perhaps most clearly see the processes of artifact mediation, collaborative knowledge building and intertwining of perspectives through analyses adopting the methodology of **conversation analysis** (Sacks, 1992) or its incorporation in **micro-ethnography** (Streeck, 1983). Digital video of interaction processes can be analyzed at a level of detail that reveals their subtle, multi-modal activities and enables systematic interpretation. (Stahl, 2001a)

5. The evolutionary implications of groupware can be conceptualized in terms of Maturana & Varela's notion of **structural coupling** (Maturana & Varela, 1987). For instance, when I developed software for a class of students to use in improving their summary writing skills, the interactions among the developers, teachers, students, software, curriculum and classroom activities led to each of these adapting to the others until an effective, productive and sustainable ecology of learning was established. (Kintsch et al., 2000)

CASE HISTORY

My own recent empirical work on these issues has focused on the adoption of three digital artifacts by groups of students:

1. **SimRocket** is a simple computer simulation of model rocket launches. I studied the use of this simulation by a small group of middle school students over a three hour period. (Stahl & Sanusi, 2001)

2. **WebGuide** is a groupware environment to support collaborative knowledge building and the intertwining of personal and group perspectives. I used this software medium in a middle school classroom and two graduate seminars. (Stahl, 2001b)

3. **State the Essence** is software that uses latent semantic analysis (Landauer et al., 1998) to compare the content of summaries written by students to the summarized text and to provide feedback to the students on how they might improve their summaries. This software was tried in a middle school classroom over a three year period. (Stahl & dePaula, 2001)

BACKGROUND

My personal background is in philosophy and computer science. Recently I was a Research Professor in computer science and cognitive science at the University of Colorado in Boulder. While there, I developed SimRocket, WebGuide and State the Essence, as well as a number of related software systems. I also offered interdisciplinary graduate seminars in issues of CSCL. Currently I am working in the CSCW group at the GMD-FIT near Bonn, Germany, where I am involved in a European project developing CSCL software for use in schools in Finland, Netherlands, Italy and Greece.

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MODELS OF COLLABORATIVE KNOWLEDGE BUILDING

Gerry Stahl

Fraunhofer Institute for Applied Information Technology FIT, Germany
and University of Colorado, USA
Gerry.Stahl@fit.fraunhofer.de
http://orgwis.gmd.de/~gerry

Model 1. Intertwining of tacit and explicit knowledge through various knowledge building activities. From (Stahl, 2000).
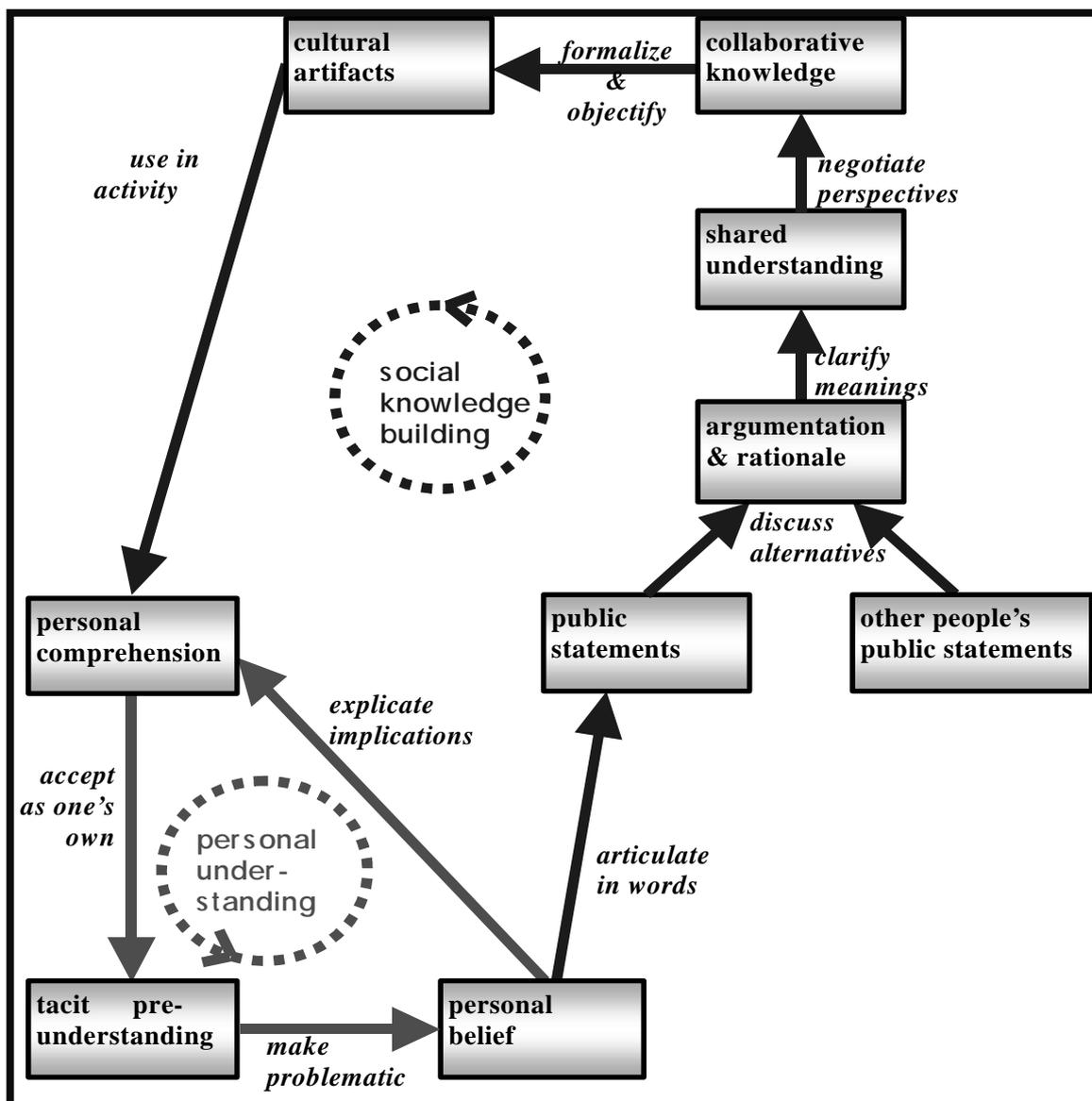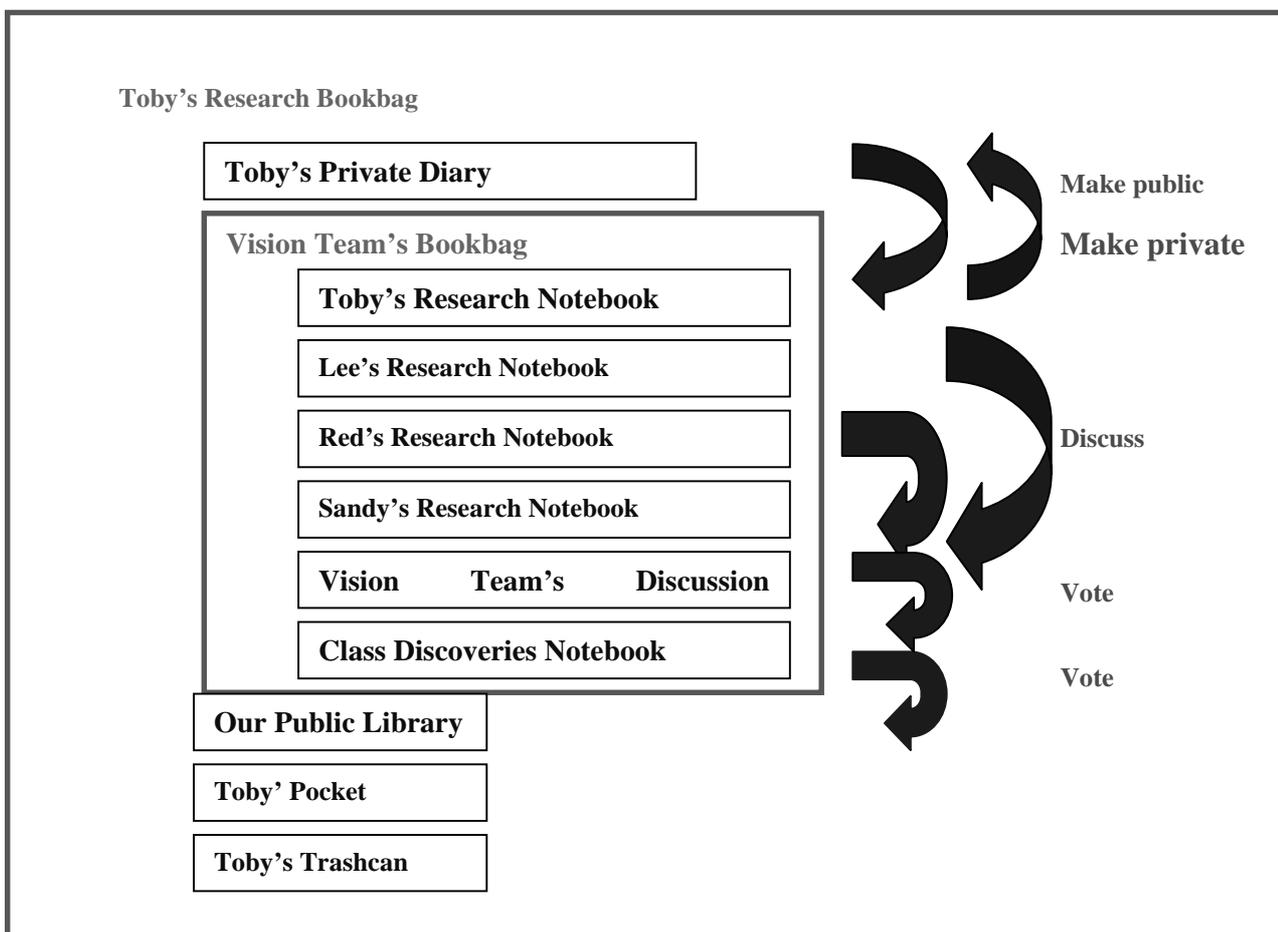
Model 2. Intertwining of personal and group perspectives in face-to-face communication. From (Stahl, 2001).
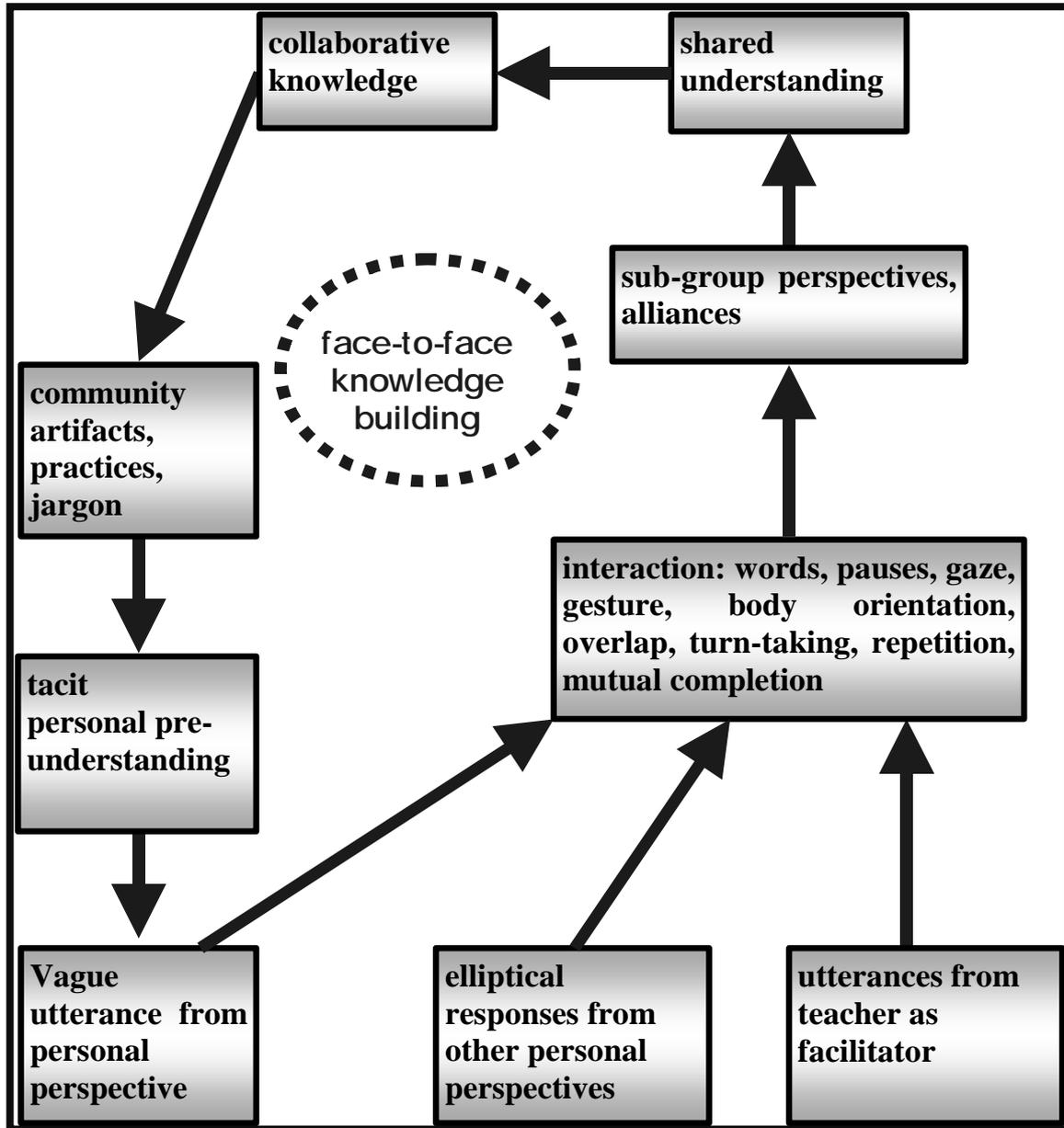
Note how this diagram includes perspectives, discourse, knowledge-building and artifacts.

MODEL 3. INTERTWINING OF PERSONAL AND GROUP PERSPECTIVES, PUBLIC AND PRIVATE WORKSPACES IN BSCL

Toby's Research Bookbag

Toby's Private Diary

Vision Team's Bookbag

Toby's Research Notebook

Lee's Research Notebook

Red's Research Notebook

Sandy's Research Notebook

Vision   Team's   Discussion

Class Discoveries Notebook

Our Public Library

Toby' Pocket

Toby's Trashcan

Make public

Make private

Discuss

Vote

Vote

MODEL 4. PROGRESSIVE INQUIRY. FROM (MUUKKONEN ET AL., 2000).

Fle2 is design to support problem based learning (PBL) and inquiry learning. Fle2 help students and teachers to engage in coordinated efforts to solve problems and build knowledge together. Process of the study course using the Fle2 should follow the following module of progressive inquiry.

Setting up the Context
A starting point of the process of inquiry is creating a context for a study project in order to anchor the chosen issues to central conceptual principles of the domain of knowledge in question. The purpose of context creating is to help the students to understand why the issues in question are worthwhile to investigate. In study course using the Fle2 the context can be set in face to face meeting, with selected readings, with a video lecture etc. Significant part of the setting up of the context phase is to jointly plan and set up goals for a study project.

Presenting Research Problems
An essential aspect of progressive inquiry is to set up questions or problems that guide the process of inquiry. Scientific inquiry can be seen as a problem-solving process: initial question define the domains where the inquiry is directed and more

refined questions guide the process. Conceptual problems that arise from students' own attempts to understand and explain the problems being investigated are helping a student to guide and regulate their knowledge-building efforts.

Creating Working Theories
Another important aspect of inquiry, and a critical condition of developing conceptual understanding, is generation of one's own working theories, conjectures, hypotheses, theories or interpretations for the phenomena being investigated (Carey & Smith, 1995; Perkins, Crismond, Simmons, & Under, 1995; Scardamalia & Bereiter, 1993). Construction of working theories guides students to systematically use their background knowledge and make abductive inferences to explain new phenomena and extend understanding. Progressive inquiry aims at facilitating explication and externalization of a student1s intuitive conceptions, through guiding students, for instance, to write about their ideas. Further, it is intended to make the differences between one1s own conceptions and scientific conceptions more salient and accessible to the student. This, in turn, is likely to facilitate conceptual restructuring.

Critical Evaluation
Critical evaluation addresses the need to assess advancement in knowledge-seeking inquiry in a constructive way. Through evaluating whether and how well the working theories explain the chosen problems, the learning community seeks to assess strengths and the weaknesses of different explanations and identify contradictory explanations, gaps of knowledge, and limitations of the power of intuitive explanation. The evaluation helps the community to direct and regulate joint cognitive efforts toward searching new information that will help advance shared understanding.

Searching Deepening Knowledge
The questions generated and working theories constructed provide heuristic guidance in the search for new scientific information by suggesting possible directions in which potential answers and more specific information can be sought. By examining one1s prior problem statements or working theories with the help of new information, the student may become aware of his or her inadequate presuppositions or background assumptions. Further, large bodies of information cannot be managed without questions that guide and constrain the knowledge seeking process and help to conceptually structure obtained information. The question-guided search for new scientific information is likely to facilitate transition from reference to problem-centered knowledge, and, therefore, elicit conceptual restructuring (Bereiter & Scardamalia 1993).

Developing Deepening Problems
In genuine problem-solving situations one has to start to generate questions and tentative theories before all necessary information is available. As a consequence, the process of inquiry often has to start with very general, unspecified and "fuzzy" questions and tentative working theories (Sintonen, 1991). In spite of gaps, weaknesses, or lack of clarity, these kinds of general questions and working

theories function as tools of inquiry and provide a basis for progressive inquiry. A critical condition for progress is that a student focuses on improving his or her theory by generating more specific questions and searching for new information. The process of inquiry advances through transforming and refining the initial big and unspecified questions into more specific questions following the interrogative model of inquiry.

New Theory
The dynamic nature of inquiry is based on the generation of intuitive explanations and acquiring of new scientific information, which in turn make new research questions and more elaborate working theories accessible to the students, theories that could not have been anticipated in the beginning of the inquiry. Through generating new questions, searching repeatedly for new information and constructing more and more articulated working theories, a student moves step by step toward answering the initial big question.

Distributed Expertise
All aspects of inquiry & such setting up research questions, searching for new scientific information, constructing of one1s own working theories or assessing the explanations generated can be shared with fellow inquirers. Cognitive research indicates that advancement of inquiry can be substantially elicited by relying on socially distributed cognitive resources, and collaborative efforts to advance shared understanding. There is, further, a growing body of evidence that cognitive diversity and variation in the fields of expertise promote knowledge advancement and cognitive growth. Through social interaction, contradictions, inconsistencies and limitations of a student1s explanations may become salient to him or her; one is forced to perceive conceptualizations from different points of view. Collaborative inquiry facilitates deepening conceptual understanding by pushing a student to commit to some idea or belief, as well as to organize and reorganize his or her knowledge (Hatano & Inagaki, 1992).

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Appendix: List of participants

Joao Batista	ISCA, Univeristy of Aveiro, Portugal jbatista@isca-aveiro.pt
Tatyana Bondarouk	Faculty of Technology and Management, University of Twente, Netherlands, t.bondarouk@sms.utwente.nl
Alejandro Fernández	GMD-IPSI, Darmstadt, Germany casco@darmstadt.gmd.de
Tony Hall	Interaction Design Centre, University of Limerick, Ireland tony.hall@ul.ie
Ilona Heldal	Chalmers University of Technology, Gothenburg, Sweden ilohel@mot.chalmers.se
Marike Hettinga	Telematica Instituut, Enschede, Netherlands marike.hettinga@telin.nl
Helge Kahler	German Federal Ministry for Education and Research, Bonn helge.kahler@web.de
Anders Mørch	InterMedia, University of Oslo and Department of Information Science, University of Bergen, Norway, anders.morch@ifi.uib.no
Ingrid Mulder	Telematica Instituut, Enschede, Netherlands ingrid.mulder@telin.nl
Uta Pankoke-Babatz	GMD-FIT, Sankt Augustin, Germany uta.pankoke@fit.fraunhofer.de
Dulce Pumareja	Faculty of Computer Science, University of Twente, Netherlands pumareja@cs.utwente.nl
Anabela Sarmento	ISCAP/IPP, S. Mamede Infesta, Portugal asarment@mail.telepac.pt
Jan Gerrit Schuurman	Telematica Instituut, Enschede, Netherlands jangerrit.schuurman@telin.nl
Klaas Sikkel	Faculty of Computer Science, University of Twente, Netherlands sikkel@cs.utwente.nl
Gerry Stahl	GMD-FIT, Sankt Augustin, Germany gerry.stahl@fit.fraunhofer.de
Oliver Klee	oliver.klee@gmx.net