Interacting with EDIT.

A Qualitative Study on, and a Re-design of, an Educational Technology System.

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Abstract

This thesis aimed to study the interaction between an educational technology system and its users and give suggestions for design improvements. The technology system is called EDIT (Educational Development through Information Technology) and has been developed and applied at Linköping University’s Faculty of Health Science. EDIT supports Problem Based Learning and enables scenarios to be presented through the World Wide Web.

The study was divided into two parts. The first part consisted of a qualitative study with the objective to describe the interaction between the students and EDIT. Students from the faculty’s medical-, nursing- and social care programs were interviewed and observed using the system. The study showed that EDIT was not fully designed to support multiple user interaction. EDIT could only be operated by one user at a time which in turn resulted in an interaction reliant on the operators technical knowledge and ability to handle the system. The second part consisted of a redesign of EDIT. The design goal was to create a groupware that could be operated by multiple users. The design solutions were presented as lofi prototypes to three EDIT users. The users approved of the ideas but stressed the danger of using too advanced and unfamiliar technology.
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This thesis was written at the request of the EDIT group, Linköping University, Sweden. It was the first study ever made with the focus on the interaction between EDIT and its users.

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1.0 Introduction

In this chapter a brief description is given of the background of the studied area. It will be followed by a presentation of the aim with this study. Thereafter a brief account will be given of how this study will be presented.

1.1 Background

New ideas and theories about learning and education have been developed during the last decades. Problem Based Learning, PBL, is one of them, concretized in the mid sixties at McMaster University, Hamilton Canada (Norman and Schmidt 1992, Melchert and Ohlin 1992). Its fundamental assumptions and educational idea was quickly spread worldwide, mainly within the field of medical education. PBL is now, however, widely used in other fields than medical education such as architecture, biochemistry, business, dentistry, law, engineering etc. (Koschmann et al 1996). The Faculty of Health Science at Linköping University introduced PBL in Sweden, in 1986. PBL is today applied at every program that the faculty offers, that is the medical, nursing, physiotherapy, occupational therapy, social care and medical biology program (Antepohl 2000).

In June 1999, the Faculty Board of Health Science at Linköping University, decided to design and develop a new Information Technology (IT) system to improve their PBL education. The underlying ideas of the system arouse during a visit to Sydney University in Australia. Sydney University’s Faculty of Health Science had applied PBL supported by an IT-system, for several years (Bergdahl 1999).

The educational technology system developed in Linköping, is called EDIT (Educational Development through Information Technology). EDIT enables patient scenarios to be presented electronically through a web page. A personal computer connected both to the Internet and a projector, enables the projection of the scenario onto a large screen. The students are able to interact with the scenario, and work through it, together. EDIT has until now been applied to Linköping University’s medical, nursing, physiotherapy and social care programs, although not every semester of each program (Antepohl 2000).
1.2 Aim
This study aimed, for the first time since EDIT was implemented, to investigate the interaction between the students and EDIT. The purpose was to describe the interaction and thereafter give suggestions for design improvements. Furthermore, the study aimed to give suggestions on how a chosen area of problem could be solved. The study focused on EDIT as an educational technology to support the PBL pedagogy at the University’s Faculty of Health Science. This also entailed a focus on PBL and educational technology in a medical educational setting on the level of higher education.

In this thesis, the following issues will be discussed and answered; how does the students interact with EDIT? What causes problems in the interaction? How can these problems be solved?

1.3 A brief description of the study
The study was divided in to different stages reflecting the design of its further presentation. The first stage included a brief description of Problem Based Learning and information technology. It was followed by a description of EDIT, how it is used and designed, with a focus on the interaction. The description of the interaction was in part based on literature but mainly on observations and interviews conducted at Linköping University. The data collected through observations and interviews were analyzed through the “constant comparative method”. The analysis is presented at the end of the first part of this study. The second stage of the study was based on the descriptions of the interaction between EDIT and its users. One main area, namely the design of EDIT as a educational tool for multiple users, was identified and described. Suggestions of new design solutions that could improve the interaction were developed and tested on a group of users. Results and an analysis from these tests are presented at the end of the second part of this study.
2.0 Problem-Based Learning

The fundamental principles of Problem Based Learning will be presented next. It will be followed by a presentation of how PBL is applied at Linköping University’s Faculty of Health Science.

2.1 Fundamental principles of PBL

The principles of problem based learning were originally introduced in Canada at McMaster University. PBL was created due to dissatisfaction with traditional education where students passively memorize knowledge from lectures and through reading (Silén 2001b, Melchert and Ohlin 1992). PBL is an idea derived from a theory about learning where knowledge is actively constructed by each learner through the learners own formulations of inquiries and questions (Gijselaers 1996, Silén et al 1989). The advocates of PBL argue that education should be student centred where the focus should be on each individual’s learning rather than on teaching and the one/ones who teach. Learning is not a receptive process but constructive, where students actively construct knowledge (Silén 2001a, Gijselaers 1996, Silén et al 1989). This is the opposite of traditional education, where students hammer a lot of facts in to their heads. The acquisition of such knowledge is examined by knowledge tests. The students end up having problems with judging the relevance of the knowledge, and when and how to apply it in a real situation (Silén 2001b, Melchert and Ohlin 1992).

It is hard to give a general description of how PBL is to be applied since problem based learning is interpreted and applied in many different ways. Howard Barrows, who has become one of the gurus of PBL, points out some characteristics of the usage of PBL in medical education nowadays (Silén 2001b):
Student centered, lifelong learning
- Learning is student centered
- New information is acquired through self-directed learning

○ The scenarios\(^1\)
  - The scenarios form the organizing focus and stimulus for learning
  - Scenarios are the vehicles for development of clinical problem-solving skills
○ The physical setting for learning
  - Learning occurs in small groups
  - Teachers are facilitators or guides

2.1.1 Student centered lifelong learning

PBL is based on student centred learning, where students take their own responsibility for their studies and learning (Silén et al 1989). The aim for the students should be to actively learn for life rather than studying passively aiming for passing knowledge tests. The students are to find their own way of learning, a way that hopefully sustains throughout their career (Silén et al 1989, Silén 2001b).

As the name implies, problem based learning is based on students learning when actively working through and solving scenarios. The scenarios raise inquiries that the students need to find answers to. Students take their own responsibility for their studies meaning that existing gaps of knowledge ought to be filled by the student using different kind of resources (Antepohl 2000).

2.1.2 The scenarios

The scenarios that the students deal with are similar problems that the student will encounter in their future profession. The scenarios make it possible to integrate different subjects showing the students the complexity of the field. This will hopefully prepare the students when facing problems in their future workplaces. It will also hopefully develop an investigative attitude among the students towards their surrounding, an attitude that they hopefully will carry with them after obtaining their degrees. Put in other

\(^1\) The form scenario is hereafter used to designate the problems that the students work with. The scenarios are a fundamental part of PBL and can in other literature be called e.g. problems, cases or inquiries.
words, the students will create a strategy for lifelong learning through applying PBL (Silén et al 1989, Silén 2001a).

2.1.3 The physical setting for learning

The collaborative work in small groups is viewed as the heart of learning in PBL. It is within the group where the knowledge is worked up and where each student’s individual achievements are evaluated (Silén et al 1989). PBL is based on students working in small group of about 6-8 persons. The students can, in these groups, collaboratively discuss the scenario and help each other out in solving inquiries and creating understanding and new knowledge. The processes in the group are guided by a “teacher”, from now on called facilitator. The facilitator does not possess the role of a “knowledge base”. The facilitator has the responsibility to guide the group members through the different processes that occur in the group (Koschmann et al 1996, Mårtensson 1991, Silén et al 1989, Silén 2001a).

PBL does altogether, irrespectively of how it is applied, make the students in charge of their own learning. PBL is an attempt to make learning more meaningful for the learner. It helps the student to apply his or her knowledge in real like situations. There is a great diversity of methods of adapting PBL. Linköping University’s Faculty of Health Science’s model of PBL was used for this study (see e.g. Silén et al 1989).

2.2 PBL at Linköping University

The descriptions of the PBL process that will follow next, is a summary of own observations made in student groups at Linköping University and from the brochure “Problem based learning - an introduction for students” (Antepohl 2000). A model of the PBL process is presented in figure 1.
The students within each program are, in the beginning of each semester, divided into small groups of six to ten students. A facilitator is included in each group. The facilitator is supposed to guide the students through the different processes that occur when a group collaborates (Silén et al 1989). The group meets up once or twice a week to work with a scenario that concerns a patient or situation. The scenarios are usually presented on paper but electronically when using EDIT. The group meetings start up (1) with the members reading through the scenario. Together they discuss trying to understand terms and concepts that are hard to understand.

The next step (2) for the students is to freely associate about the scenario. The aim is to prevent a premature “solution” or discussion that can hinder the group work. Thereafter, (3) a systematization of the information gathered from step 2 is made. The systematization usually appears as categories or headings to which areas with similar meaning are connected.

The next step (4) for the students is to make an inventory of the information that each group member is holding. They have to make use of the knowledge that the group and its members already possess. Thereafter, (5) the group has to compose inquiries about the knowledge that they lack. From these inquiries (6) the students formulate their so-called learning issues: What do I/we need to learn to be able to answer my/our inquiries? What more information do I/we need, to get the proper knowledge both for the scenario but also for general application? How are the inquiries related to the goals of learning that are formulated for each semester? The group is thereafter dissolved (7) and each member of the group must use different kinds of resources to acquire the knowledge.
required to fulfill the learning issues. The group meets up (8) a couple of
days later and collaboratively works through and values the knowledge that
each student has gained individually. Finally, (9) the general knowledge is
applied on the specific scenario.

It may happen that the students at the end of the session have not found all
the answers and explanations needed. Or it might happen that new inquires
arise when the students pass stage 9. The students could then use other
learning resources to fill their gaps of knowledge. It should be stressed that
the PBL process and the group work described above are not isolated from
the learning context. PBL does not function without other learning
resources. Some of the learning resources that are used in PBL curricula in
Linköping are lectures, seminars, internship, field studies etc (Antepohl
2000).
3.0 Information technology in learning environments

This chapter includes a brief summary of the considerations that ought to be included in the design of educational technology. Additionally a presentation of educational technology available today will be given with a following thorough description of EDIT.

3.1 Considerations when designing and applying educational technology

The integration of technology into different kinds of learning environments has during the last decade become more and more common. It can even be argued that “the introduction of technologies into human activities, and the use of such resources for learning and for the mastery of complex activities is nothing new” (Säljö 1998, p.145). Humans have, throughout history, sought to develop technologies that can help solving practical as well as intellectual problems (ibid.). Information technology has provided us with the opportunity to “alter, enhance and otherwise improve traditional forms of instructional research” (ibid. p.12). Integrating and applying technology into learning environments is not easy and the results are not always successful (Säljö 2000, Laurillard 1997).

The focus on computers, the Internet and other kinds of information technology has rapidly increased since the early 90’s and has become a valuable tool and an important medium for education (Wulff et al 2000). Most of the future jobs will include information technology, and this has made the integration of technology in education, particularly in higher education, even more important. Different kinds of educational technology have been developed and applied throughout the years. The visions are often innovative and exciting but often very costly (Margolis 2000). The use of educational technology has become a political and economical question as well as a question about teaching and learning (Margolis 2000). It has been found that students in impoverished school districts and households have less access to information technology than peers in more affluent schools. Even if the access to computers and the Internet is growing, the use of educational technology qualitatively differ; “middle-class students using computers in more innovative and engaging ways than
students from lower-income families” (Koschmann in press). Further, there is a great diversity among students nowadays and the concept of “one curriculum for all” is not applicable anymore. The students come from different cultures, social classes and with different experiences, linguistic and academic backgrounds (Gilliani 2000). Some studies show gender difference in the usage of computers and technology as well. Girls seem to be less interested and knowledgeable in the use of technology than boys (Koschmann in press, Light and Light 2000). These diversities do altogether demand a more personalized and student-centred design of educational technology, where each individual’s needs are taken into consideration (Gilliani 2000).

3.2 Educational technology today
Technology in educational settings can be used in many different ways. Examples of technology already used in these kinds of setting are:

- **Simulation and Virtual Reality**
  This is a field based on situated learning. The technology enables the students to practice their skills in a virtual world that is simulated through technology. The students can practice on skills in a context similar to reality. This technology has for example been used in medical education, in the education of pilots etc. (Sundelin 1999, Waterworth 1999).

- **Distance Education**
  This kind of technology enables the students to learn together even if the students are located in different places. Students and teachers can interact with each other through the Internet, using such things as email, chats and videoconferencing (Cole 2000).

- **Face-to-face collaboration using technology**
  Technology is also used in face-to-face collaboration. Studies on how for example children collaborate through the usage of computer and different software, has been carried through by authors such as Stewart et al (1998). An example of a technology supporting face-to-face collaboration is EDIT. A more thorough description of EDIT will be presented at the end of this chapter.

3.3 Integrating IT in PBL curricula
Using information technology to support PBL in a face-to-face learning environment, is however one of the areas that still has undergone very little research (Light and Light 1998). PBL can be accomplished without computers although support by computers intended to “better coordinate collaboration and to provide portable and external memory to students, further aiding their learning” (Koldner and Guzdial 1996 p.309). A brief description of what ought to be included in the design of educational
technology used in a PBL context will follow next. The presentation is based on the division of important elements in PBL according to the scheme presented in section 2.1.

3.3.1 **Student centered, lifelong learning**

An educational technology used in a PBL context should support lifelong learning. It should be designed so that all students will be able to take own responsibility for their studies. The diversity among students is quite large nowadays and this fact should be taken into consideration when designing educational technology (Gilliani 2000, Margolis 2000, Koschmann in press). The technology should also give the student an opportunity to freely create an own strategy for finding answers to their inquiries. The system should not control the student. It should give the student a chance to develop an investigative attitude towards its surrounding. The scenarios, that the students’ work with, ought to be presented to them in a way that stimulates an investigative attitude and supports lifelong learning.

3.3.2 **The scenarios**

New media can nowadays create contexts that are real-like. It enables learning from real-like situations. The inclusion of sound, graphics, video clips, audio clips etc. in scenarios makes it possible for students to observe aspects of the real world in an different way than from carefully formulated “textbook” examples. The textbook examples might not generate so many different problems and questions. The scenarios can, when mediated through new media, be complex and ill-structured like in the real world. This makes it possible for students to really investigate different aspects of problems that resemble those they may encounter in their future workplace (Koschmann in press, Laurillard 1997). This is an advantage that should be considered when designing educational technology for a PBL curriculum.

3.3.3 **The physical setting for learning**

PBL is based on students working together in small groups, which in turn means that the technology should be designed as a groupware used by multiple users. It is always important to design technology so that it suits its users (Hackos and Redish 1996). Laurillard (1997) argues that the technology has to be naturally embedded in the student’s curricula. The system ought to be developed and integrated with the reminder of the student’s courses. “In particular, teacher’s attitudes, other course teaching, scheduling, logistics, administration, briefing and de-briefing, technical and
academic support and student assessment, must all be conductive to enabling students to use the new technology to the full” (p. 226). If these criteria are not fulfilled, the technology will fail no matter how good the material is (ibid.).

Altogether, “a frequent charge levelled against technological innovations in education is that they often seem to be designed to exploit the capabilities of the technology rather than designed to meet an instructional need; that is, that they are technology-driven rather than theory-based” (Koschmann et. al. 1996 p. 83). This is an important fundamental issue that ought to be remembered when creating educational technology. The design should be based on the pedagogy rather than on the technology available. In other words, educational technology used in student-centred curricula should also be designed to suit this form of pedagogy.

3.4 EDIT- a new IT-system to support the PBL curricula

The EDITproject aimed at creating scenarios based on the Internet and World Wide Web. These scenarios were created for each suitable semester, at each program that the Health Faculty offers. The main objective were to bring about a pedagogical renewal and development of the PBL curricula. Another objective was to upgrade the content of the Health Faculty’s educational material (Bergdahl 1999). The project also aimed to support the faculty’s integrated teaching and to develop an interactive evaluation system that is easy to handle (ibid.). Altogether, EDIT was not created for simulations or distance education. It was created as a system supporting PBL in a face-to-face setting.

3.4.1 EDIT in practice in a PBL setting

In accordance with PBL, the EDIT scenarios are the basis of learning. EDIT is designed to be used by a small group of people, each group having one facilitator that guides them through their sessions. EDIT is designed to support PBL and enable the presentation of scenarios in a more realistic way by the usage of multimedia elements such as video clips, graphics, audio clips, hypertext etc. The multimedia elements should create scenarios that are similar to those the students might encounter in their future workplace. The students should through the scenarios gain a learning strategy that they are able to use through out their career.

The PBL process is in theory the same for paper based scenarios as for EDIT. The main visual difference is that the scenarios are presented
electronically. The problem is presented through a web page designed by faculty staff. The web page contains all the scenarios that the students should work through during the semester. The scenarios are divided into two or three parts, hereafter named short and long scenarios. The first part of a scenario contains a description of the problem. It can for example contain a brief description of a patient entering the hospital with pain in the stomach. The students can be given information about such things as what medication the patient is given and what kind of tests are made. The students can sometimes watch a video clip of for example a nurse examining the patient. They can, through that, see how both the nurse and patient act. All this information gives the student a chance to create a picture of the patient, what has happened, why and what should be done to improve the patients situation. The students might not have answers to all of their questions. It will be their responsibility to fill those gaps of knowledge in accordance with PBL. The second and/or third part contain more information about what is done to improve the patient’s situation. More questions are generated and the students have to use different resources to fill their possible knowledge gaps.

Picture 1. This is an example of a video clip in a patient scenario projected on a smart board.
One part of the scenario is examined at each session. The students in Linköping are divided in groups of 6-10 students including one facilitator in each group. A data projector connected to a regular PC, projects the web page on a large screen. The scenario is visible for the whole group as picture 1 shows. The students interact and navigate the scenario using a mouse and a keyboard. The input devices are wireless. But the cordless mouse and keyboard have to be directed towards the computer to ensure its function. The students go through the same nine steps described earlier in section 2.2. This means that they also need technology to be able to write down notes from e.g. the association- and brainstorming steps. The equipment used for this can however differ quite a lot depending on the location of sessions. The students always meet in the same room, which also means that the student work with the same system and technology throughout the semester. The rooms are equipped with either of these two technologies:

1. The screen, on which the web page will be projected, may consist of a regular screen usually used for projecting overheads. The screen is usually pulled down in front of a regular whiteboard. The students write their notes from the association step and brainstorming step either on the whiteboard or in an electronic word document using MS Word.

2. The screen may also consist of a so called smart board. A smart board is an interactive whiteboard that makes it possible to write or draw on its surface with pen like input devices. The students are able to interact (pull, move around, save, email etc) with the words they have written, by touching the screen with their fingers or by using the mouse.
3.4.2 EDIT vs. paper based scenarios

EDIT is not introduced to any first year students at any program. The students practice PBL with paper based scenarios during their first semesters. EDIT is not introduced until the third or fourth semester depending on which program the students attend. Observations were made in two groups using paper based scenarios as an attempt to better understand the difference between the two ways of presenting and working with scenarios. The groups observed working with paper based scenarios, were picked randomly. The groups consisted of one group of medical students and one group of nursing students. The PBL process is the same for paper-based scenarios as it is for scenarios presented through EDIT. The PBL curriculum forces the students to discuss, associate, write down words, group them together and come up with inquiries that help them fulfil their knowledge gaps.

One of the differences between EDIT-groups and groups using paper based scenarios, is that the EDIT scenarios contain more varied data (Compare examples of scenarios in Appendix A, a paper based scenario, and Appendix B, screen shots of a EDIT-scenario). A scenario presented through EDIT can contain video clips of for example patients interacting with a doctor or a social worker. It may contain pictures of x-rays, lab
reports, patient descriptions etc. EDIT makes it possible to use different kinds of presentational techniques such as texts, hypertexts, audio clips, pictures, video clips etc. It makes it possible to gather all this information at one place instead of having the information spread out on different papers, video tapes, audio tapes, as a paper scenario requires. EDIT provides the students with a window in to the outside world. It gives the scenarios a more authentic and realistic touch, which hopefully makes the students more motivated, and also more prepared when facing similar problems in their future workplace.

EDIT’s design enables the students to work with one common focus. The scenario is projected on the screen in front of the students and the students read through the scenario together. They also take notes together on the smart board, in an electronic text document (MS Word), or on a regular whiteboard. Some of the groups do even use different kinds of software that enables them to draw mind maps and other kind of notes. EDIT does altogether give the students a common focus, something that the paper scenarios lack. The students working with paper-based scenarios have one copy each of the scenario that they focus on. The observations show that even if every student works with the same scenario, the focus will not be common for the whole group.

The groups working with EDIT were observed to collaborate better as a group than student groups working with paper-based scenarios. The EDIT students share their focus and make everyone active in the work and discussions. The students using paper-based scenarios seem to lack this ability. Students in the paper based groups were frequently observed discussing in small groups of 2-3 students, with each small group having their own focus. Many students in the paper based scenario groups were also observed contributing hardly anything to the group discussion. This never occurred in the EDIT groups.
4.0 Describing the interaction between students and EDIT

This chapter presents the theories and methodological considerations that have been taken into account when collecting data. Thereafter, the observed data will be presented followed by data gathered through interviewing both students and facilitators. This chapter will end the first part of this study. This will be done through a discussion about the presented data and the discovered areas that need to be improved.

4.1 Methodological considerations

The student’s behaviour when interacting with educational technology systems like EDIT is strongly bound to the technical system itself and how it is designed. But it is also bound to the context surrounding the technology such as the group and its members, the milieu, the artefacts etc. (Hackos and Redish 1998). Furthermore, it is also bound to the context of pedagogy as well. It would, in EDIT’s case, be the context of PBL. The students have to follow the pedagogical steps that are formulated by the faculty in accordance with the theories about PBL.

The importance of including the contexts in the description implies that the study needs to be carried through in the natural setting where the interaction includes all the elements in the context. That is why the study should be designed to follow theories and methods that stress the importance of field studies that take place in the natural context. This kind of studies, where you try to understand something that cannot be measured or counted in numbers, are called qualitative studies (Svensson and Starrin 1996).

4.1.1 Ethnography

There are different kinds of approaches in the field of qualitative studies. The one selected for this study is ethnography. The advocates of ethnography are interested in trying to understand and describe situations that occur in the society. They investigate how persons behave in relationship to their context, the persons participating and the situation that the behavior occurs in (Silén 2000). The researcher has to focus on what
the persons studied do and how they do it, and what the doing means (Hartman 1998). The Ethnographer does altogether try to create a comprehensive view of the phenomenon studied rather than focusing on particular variables (Silén 2000). This is, according to the Ethnographers, best done through studying a person’s conduct in his or her natural setting. The whole situation however, including the context and participating persons, have to be taken into consideration (Rothe 2000).

An ethnographical study has a design based on discovery. The data collection process occurs in parallel with the analysis. The data collection and analysis constantly lead to new inquiries and methods that guide the data collection. Since the importance lies in studying the phenomenon in its natural setting, it also implies the importance of the researcher being in and taking part of what happens in the natural setting. The researcher can, by conducting field studies over a certain time, become familiar with the context that is the milieu, people; their thoughts, opinions and behaviour, and everything else that might influence the interaction between these elements studied. The data are also compared with theories during the collection process. The fact that the researcher stays in the context makes it possible for the researcher to relate selection, inquiries and methods to occurrences that take place in the field (Silén 2000).

The data collection can be conducted by use of for example interviews and observations which are analyzed through different methods. (Henriksson and Månsson 1996, Starrin and Renck 1996). The ethnographic approach does however lack a good method of analyzing the collected data. This is why the method of analysis for this study is based the constant comparative method (see e.g. Silén 2000).

4.1.2 Constant Comparative Method

The constant comparative method is a theory derived from Grounded Theory (Silén 2000). The data collection is done in parallel with data analysis, a process named “coding” (Starrin 1996). Coding implies discovering and developing concepts through giving an occurrence or phenomenon a name. The first occurrences are always qualities. Categories are thereafter created from them (Hartman 1998). The process ought to be comparative, meaning that different occurrences, phenomenon, created categories, concepts and qualities are compared with each other through out the whole process (Starrin 1996). Core variables are usually found when the data collection has proceeded for a while (Hartman 1998). When for example the interaction between EDIT and the students was observed,
differences between the ways the student groups’ interact with the system, was found. Many affecting phenomena and qualities were found that described this difference. Some student groups did for example work slowly while other groups worked faster. Some chose not to use some equipment available since it slowed the group collaboration while the technology improved the collaboration in other groups. Phenomena like these generated for example a category named efficiency with subcategories smart board, regular whiteboard and electronic text document. The core variables do become the basis for the new theory which is the goal of grounded theory (Hartman 1998, Silén 2000). The aim of this study is however not to develop a new theory. But the constant comparative method was used as an aid to systematize and structure the collected data.

The constant comparative method enables the description of the interaction. But there is also a need to understand the interaction. The constant comparative method was used in combination with the principles for hermeneutic interpretation. The hermeneutic analysis is based on analyzing the whole, and the parts of the whole, by turns. The data collected is interpreted as a whole. Parts of the whole are thereafter analyzed, based on the meaning of the whole. Further analysis of the parts may in turn change the meaning of the whole, which in turn might change the interpretation of the parts. This is a process that continues until a reasonable meaning has been found (Kvale 1997).

### 4.2 Observations

In accordance with the ethnographical approach, the data for this study were collected in the natural setting of the interaction. The data were collected primarily by passive observations and thereafter by in depth interviews. The results from the observations will be presented first, followed by the results from the interviews.

The decision of conducting passive observations was based on the assumption that this kind of observations would interfere the least with the interaction between the students and EDIT. The observations were made without any “observation schedule” since the aim was to do open observations and to get data to describe the whole interaction rather than certain parts of it.

It was not possible to observe all the groups that use EDIT. A selection had to be made. The selection was based on the urge of getting as great variation as possible within the framework of a study of this size. Three of the health faculty’s programs were chosen namely, the social care (students attending semester 3), nursing (students attending semester 3) and medical
program (students attending semester 5). These programs were chosen since they are the programs that use the system on regular basis. The three groups also use scenarios created specifically for each program. The third semester nursing students and the fifth semester of medical students were chosen since they had worked with EDIT for a while and were used to the system. This would eliminate the problems with novice error. The third semester social care students were chosen since they were novices in using EDIT. An additional reason was that their program differs quite a lot from the other two and thus a greater variation of the result may be expected.

However, further selections had to be made. Two groups of students from each program were selected for the observations. The groups were randomly selected except for the two groups from the medical program. These were chosen since these groups used the interactive smart boards when interacting with EDIT. The choice of two groups from each program was based on the requirement of validity and the amount of data that would be collected. Visiting one group would not give enough validity since one group's behaviour might be specific for that particular group. Choosing more than two groups would generate too much data to fit the workload of this study.

One group at each program was visited once while the other groups were visited twice.

Each group had to be observed twice in succession, partly to increase validity (what are regular behaviours and what are just accidental occurrences) but also since one scenario is not finished at a single session. It can take two or three sessions before a scenario is worked through and finished. It all depends on the scenario, how it is designed, divided and structured. However, some of the groups could only be visited once due to holidays and the absence of group meetings.
<table>
<thead>
<tr>
<th>Program and Group</th>
<th>Observation 1</th>
<th>Observation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical Students I</td>
<td>Short scenario.</td>
<td>Long scenario (2 months after obs. 1).</td>
</tr>
<tr>
<td></td>
<td>Part one.</td>
<td>Part two.</td>
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<td></td>
<td>2 Hours</td>
<td>2 Hours</td>
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<tr>
<td>Medical Students II</td>
<td>Long scenario.</td>
<td>No second observation.</td>
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<td></td>
<td>Part two.</td>
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<td></td>
<td>2 Hours.</td>
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<tr>
<td>Nursing Students I</td>
<td>Long scenario.</td>
<td>Long scenario (same as obs. 1).</td>
</tr>
<tr>
<td></td>
<td>Part one.</td>
<td>Part two.</td>
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<td></td>
<td>2 Hours.</td>
<td>1 Hour.</td>
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<tr>
<td>Nursing Students II</td>
<td>Long scenario.</td>
<td>No second observation.</td>
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<tr>
<td>Social Care Students I</td>
<td>Short scenario.</td>
<td>Short scenario (same as obs. 1).</td>
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<td>Part one.</td>
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<td>2 Hours.</td>
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<td>Social Care Students II</td>
<td>Short scenario.</td>
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<tr>
<td></td>
<td>2 Hours.</td>
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</tbody>
</table>

Table 1. An overview of the study groups and observation program.

The observations were not recorded on videotape mainly because groups or members of groups did not like the idea of being videotaped. Some of the rooms where too small, which would have made it hard to get the whole room including all the group members and equipment on tape. Notes were however taken and a fair copy of them was made straight after each observation. Observations were conducted for two hours a session, with some exception as Table 1 shows. These were shortened since the group were to make their mid semester evaluation of working with EDIT.

As mentioned previously, the constant comparative method was used to systematize and structure the collected data. The coding could practically be done in different ways depending on what kind of data that was to be collected. It could be done row-by-row, sentence-by-sentence, or the whole document at ones. Each observation in this study was coded one by one,
each one as a document. The different behaviors and happenings in each group were written down and compared with the other groups. For example, one group interacted a lot with EDIT in the end of the session while others interacted with EDIT the whole time. This analysis and comparisons lead to categories presented next.

4.2.1 Analysis of observed data

The categories found represent notions that constitute actions that occur when the group interacts with EDIT. The main categories and its subcategories will be presented together. The categories found were; constellation, roles, design, efficiency and realism. The categories represent factors that affect the interaction between students and EDIT

Constellation

The set of students and the facilitator will hereafter be call “the group”. The group also includes the room equipped with EDIT. All three elements, e.g. students, facilitators and the working milieu, seem to affect the interaction in different ways.

Milieu

The observations showed that the milieus where the students were located did affect their interaction in different ways. Some of the groups were for example located in such small rooms that they could not view the screen properly. They always had to move around when they were about to work with the scenario to be able to participate in the interaction.

Other groups had problems with the location of the computer. One group lacking a wireless mouse and keyboard, had to place one student in front of the computer. The student placed at the computer, had to face the computer screen while navigating. The other group members were at the same time facing the large screen in another direction. The milieu did in other words make it impossible for the whole group to view and interact with the same screen. It did also hinder face-to-face collaboration. Another group, using a cordless mouse and keyboard, did have problems with the connection between the input devices and the computer. Figure 2 shows a map of their tutorial room.
The operator of EDIT had to point the mouse and keyboard towards the computer to get the input devices to function properly. These were pointed at the computer standing in one corner of the room. The large screen that the group was watching was facing the operators back. The distance between the mouse and the computer screen was a couple of meters. It was therefore hard for the student to navigate; she was too far away to see the computer screen and navigate through looking at it. The technology did in turn force her to direct her body in the direction of the computer. She had just one option; navigating with her head turned around facing the large screen. This made the interaction fairly complicated for the student. This is a good example of how the milieu affects the interaction. These groups might have had less trouble interacting if they were placed in another room or if the room was furnished in another way.

**Constellation of group**

The group constellation is also an important factor that concerns the interaction. The members of the group need to function together to be able to collaborate. The observations show that the groups work differently with EDIT depending group constellation and how the facilitator works with the students. One facilitator observed did for example help the group make a
time schedule based on the facilitator’s pre knowledge about the scenario. Another facilitator in another group did not say much at all during the whole session. The group who gained the pre knowledge could then calculate how much time they would need to spend interacting with EDIT while the group lacking this knowledge did have to make a preliminary schedule and interact with the system to find out if the schedule would work out.

Roles

Members of a group always possess different roles. Some members are leaders others are followers. Some like discussions while others are more quiet and do not say anything until they have something important to say. Some roles reflect the student’s personality while others are more related to the constellation of the group. The roles are often unavoidable and needed for a group to function. The observations showed that the interaction with EDIT did not only create roles but it was also reliant on students having knowledge required for taking certain roles. The roles were mainly distributed though the student’s personality, the group and EDIT.

Roles reflecting personality

Students studying through PBL need to take their own responsibility of their studies. This does for example mean that students have to learn how to express themselves in front of their group, to get their questions answered or to contribute to the discussions. The observations showed that most groups had persons who were very talkative and took a lot of space while others were more quiet and silent. However very few students said nothing. Most of the students talked and interacted both with EDIT and the other students. The observations did however show that some students taking more dominant roles, did also control more of the interaction. They shouted out what they did not understand and what they wanted to look and discuss a bit further. It is however hard to say if they with this behavior hindered the other students.

Roles created by the group

There are also other roles that the students take when interacting with EDIT. There are the roles created by the group. An example of such roles was observed when one groups picked a chairman for the session, who was responsible for keeping track of the time. Such roles were also observed in groups using paper-based scenarios. Thus these roles did not characterize solely students interacting with EDIT.
Different roles were created as well, when persons were picked for different assignments. “You go ahead and start the discussion, because you are so good at it” is an example of a phrase expressed by one student in a group to another member. The group did indirectly give one student the role as a starter of the discussions since he usually did that and he was good at it as well. Some groups did also give some of its group members the role as the writer since the student was considered as a fast writer with satisfactory handwriting. These are all roles created by the groups and some of them did affect the interaction. A fast writer on a smart board did for example improve the interaction by making it work fast and smoothly.

**Roles created by EDIT**

A third and last distributor of roles is EDIT. The system creates roles that, compared to the other two categories, are necessary for the interaction between EDIT and the students. EDIT is a technological tool that is used by students with differing technological knowledge and experiences. Somebody or some members of the group have therefore to be able to take the position of the technologically knowledgeable. That means that students or facilitators need to be technologically knowledgeable to enable the interaction. The observations showed that less technical problems occurred in groups where students or facilitators had technological knowledge. One group reported that they had had problems with converting a file from one software to another. This problem was however solved by a student and did not cause the group much trouble at all. This group included a couple of students that solved the group’s technical problems. Another less technically knowledgeable group, did for example have problems with simpler things such as logging on to the computer, turning on and off the equipment etc. These were expressed as frequently occurring problems that no one in the group seemed to be able to solve. The group did not have any member who was able to hold the role as technically skilled and thus solve the problems that occurred in the group.

EDIT does also create roles due to its design. The scenarios can only be navigated using one mouse and/or the keyboard. This implies that only one person can control the scenarios and software. Although multiple users could use the whiteboard and smart boards at the same, this was never observed. It was always a single person writing on the board. This implied that EDIT did, due to its design, create the role of a “navigator” and/or a “writer” in each group. Most groups observed varied the possession of these roles so that all students had a chance to use the system, regardless of their level of technological skills. The role as a writer was taken by students in groups using paper based scenarios as well. Most of the writing was done in the students’ own notebooks. EDIT in turn, forced the group to
have one writer. The group worked together and most of the notes were written down together as well. The student operating the input device, thereby possessing the role of a writer, wrote the notes.

**Design**

One issue that affected the interaction was the design of the technology. The observations showed that the different aspects of the design of EDIT’s equipment, software, scenarios and interface affected the interaction in different ways. It can however not be stated that the design is the *only* reason causing a specific behavior.

**Design of equipment**

The design of the technology is highly related to the category “roles created by EDIT” presented above. These roles of navigator and writer seemed to cause problems for the student possessing the specific roles. The observations showed that the student possessing the role as the navigator and/or writer, was left outside of the group. The student was usually so occupied with writing and navigating that no time was given for him or her to fully take part in the discussion. The student possessing the role of a writer in a group using whiteboard or smart board, was forced to leave the group to be able to interact with technology. The student at the board became an outsider. The observations showed that some students had more problems with this than others. Some students were able to also hold a level of discussions in this role, while others could not. The design of the technological equipment altogether restricted the group’s ability to interact with EDIT. This had to be done by one student, who in return was left outside of the group.

**Design of Software**

When the students meet up at the sessions, they follow the nine steps in the PBL cycle (p. 9-10). Step three is called systematization. The students grouped together those words from the association process that had some kind of resemblance with each other. The social care and medical students used a whiteboard or a smart board. The nursing students who used MS Word did not go through with this step. There may be many possible reasons for this choice. One reason was noticed to be the constraints of the software. The software did not support this step in its design. It did not enable the students to easily rearrange the words into proper groups.
Design of Scenarios
The amount of information in each scenario may vary considerably. This affected the students when interacting. Many students were dissatisfied when the scenarios were too shallow and did not contain enough information to get the discussion going. There was dissatisfaction also when the information in the scenarios was extensive. The students tended to rush through the information without having any chance of really discussing its contents. Some students complained during the observations about the difficulty in planning the time schedule. It was, according to them, impossible to know how much information they were supposed to go through and how long it would take. A few facilitators assisted the students with setting up approximate timeframes for each part of the PBL process.

Design of Interface
Many of the student groups had problems navigating through the information. Some groups where observed missing a link or icon due to its location on the page. The students did however mainly run into problems when they had to navigate back to information they already accessed. The students had problems remembering which link on which page lead to some specific information. The students had to remember and guess their way around. This situation generated different options from the students. This situation was observed as time-consuming, but also stressful for the navigator, who had to select which option to try.

Efficiency
EDIT is composed by several modules that are loosely integrated. The observed groups used different artifacts when they work with their scenarios. The medical students were the only student groups having access to smart boards. The social care students used regular whiteboards while the nursing students were hardly ever observed using the whiteboard. All of the observed groups used different software as well. Medical students used MS Word and/or software aimed for the smart board. The nursing students used MS Word while the social care students did not use any software at all although they had access to MS Word. They all used different technology and did also work differently.

Regular Whiteboards
The rooms used by the social care students were equipped with regular whiteboards. The students did neither use the scenario nor the whiteboard during their initial discussions. The students did not interact with the scenario until they had gone through a new or a new part of a scenario. The
whiteboard was used when the students reached the association step. One student stood at the board and wrote down what the other group members said. The regular whiteboard did not enable the written text on the board to be saved. The students wrote down the notes by hand in their own notebooks instead. This was done after the systematisation step so that the students could focus and concentrate on the right things at the right time. It was also done to give the student standing at the board a chance to write as well. This was observed as a very time consuming step, which took more than five minutes.

**Electronic text documents**
The nursing students did interact quite a lot with EDIT. Both of the groups observed used the scenario as a basis for discussion. EDIT was due to this used very actively. The students did for example bring up patient’s anamnesis when starting the discussions; “Well, let’s see. The anamnesis says that she had an aching stomach and he was not given any medicine. Has someone found anything about medication for stomach ache?” This quote exemplifies how the students apply the case in their discussions.

The students used MS Word when they reached the association process and needed to take notes. The document was distributed to all the group members through email or as a printed copy. One of the groups had their own group web page. The group members email addresses were connected to the page and documents could easily be distributed through it. The other group saved their documents on a floppy disc. The facilitator rushed out of the room at the end of the session to print a copy to each student from her own computer, located in the same building.

**Smart boards**
The medical students were the only two groups of the ones observed, who used smart boards. One of the groups had, however, decided not to use the smart board. The technology was too complex for the students to use, and it did, according to them, result in inefficiency. They used a regular small sized whiteboard instead. This whiteboard was placed on the table in front of the student and used as a note pad during their discussions. The students spent a lot of time discussing and drawing on the whiteboard. EDIT had a passive role during most of the discussions. They only used the scenarios to find some specific information or when a new scenario or part of a scenario ought to be gone through. A word document was used when the students started with their associations. The text document was emailed to each member of the group.
The medical students who used the smart board did in turn use it fully. The students spent a lot of time interacting with the different elements in the scenario while they discussed. EDIT seemed to be a basis for their discussions in the same way as for the nursing students. The students started using the smart board when they had gone through a new scenario or part of a scenario. One student interacted with the board and seemed to have great knowledge in how to use it. The work seemed to flow very effectively that is there were few interruptions and disturbing elements in the interaction. However, the notepad, where the notes were written, and the scenario, could not be kept visible on the screen at the same time. The students had to remember the words and ideas that were generated when reading through the scenario. The words could not be written on the board until the notepad was visible on the screen. The words and groups created during the session were saved on the computer but also emailed to each student through a students private email account. The document was also printed and each student received a copy of the notes. All this was done by the operator while the other students carried through an evaluation.

**Realism**

The amount of realism that the system expressed seemed to be an important element in the interaction between the students and EDIT. The system seemed to make the scenarios more authentic for the students than paper-based scenarios did. Students interacted with EDIT as if the patients described in the scenarios were real. One of the observed groups was watching a video clip of an old lady refusing assistance. The students discussed the ladies problems, as the problem existed for real; “What should we do to help Ulla [the fictive name of the patient]” “I wonder how her home situation looks like? Does she get any help from her family?” “What do we do when she says no like that? We can’t go behind her back”. The students gestured and pointed at the picture of the lady as they discussed her case. These behaviours could not be observed in student groups working with paper-based scenarios.

**4.3 Interviews**

The open observations did not only generate a description and understanding of the interaction between the students and EDIT. It also demonstrated that to create a greater understanding of the interaction, in-depth interviews with the students and facilitators had to be accomplished.

Interviews can be carried out in different ways, depending on the information to be collected. The main goal when interviewing the students about their experiences with EDIT was to gain the students perspectives
about working with EDIT. Which parts of the interaction were important to them and what were their experiences? The best way to get their views and perspectives was to make an unstructured interview. That is when the researcher asks and actively listens in order to understand what is important in the setting and what the interviewee considers important. The unstructured interviews are not guided by specific questions, it is rather the person being interviewed that talks and the researchers follow up with proper questions ( “why?” “Give an example”, “explain that part”, “have I understood you correct if...? “), as an attempt to understand the person being interviewed in depth (Kvale 1997, Maykut and Morehouse 1994). However, a brief interview guide was used in these cases, mainly to help cover all the topics that ought to be discussed. I wanted to know if they viewed the different situations and phenomenon in the same way as I did or if there were other points of views. The questions were however very broad since to specific questions would probably have hindered the interviewee to think and discuss freely. The questions were to function as a guide to get the discussion started and going, rather than pure form of questions that could be answered through a couple of sentences. After the first interview was conducted, the structure of the interview guide was changed slightly. The interview guide for the students consisted of six broad questions and the facilitators interview guide consisted of four broad questions (Appendix C). All of the questions were based on the categories discovered in the analysis of the observations.

The interviews were held individually, and they were located in places that suited each person best, such as their home, cafes or at the university. The interviews were not recorded on tape. The decision was made that notes would be enough to fulfil the purpose of the interviews. To create an as accurate record as possible, a fair copy of each interview was made straight after each interview.

A method called meaning concentration (see e.g. Kvale 1997) was however used to as a first method of analysis. The idea of the method is to reduce the masses of data that the interview generates, as an attempt to find the essential meanings of the interview. The meaning is then concentrated into short and concise sentences that, in this study, were analyzed through the constant comparative system (Kvale 1997). The interviewees talked for example about how they experience EDIT, which generated a lot of text. By finding out the essential parts of their answers, concise sentences could be created that described each interviewee’s opinion and experience. The sentences were then categorized with relating subcategories connected to the main categories.
4.3.1 Selection of interviewees

There were two different categories of interviewees in this study; firstly the main users of EDIT, namely the students. The second group was the facilitators.

Students

Each student from the observed groups was asked to voluntarily participate in the interview. The students were contacted both face-to-face and through email. It was however only students belonging to the observed groups that were asked to participate. It was considered rewarding to discuss the observation with someone who participated in the specific situations. The interest for participating in the interviews was low due to the fact that the interviews were conducted at the end of the semester, during exam period. Most of the interviews were made face to face. One interview was done over the phone due to the student’s lack of time.

The selection was based on the categories founding the observations. The aim of the interviews was to find out the students opinions about factors influencing the interaction. The answers were then connected to the categories presented previously, as an attempt to create a holistic understanding of the interaction. An important factor in the selection process was to create variation among the students. The goal was to broaden the understanding, not describing something that most of the students in the groups thought and felt. The following categories were to be covered:

- One female student
- One male student
- One younger student (-25)
- One older student (+25)
- One student from each program
- One student that belonged to a group where the interaction was satisfactory.
- One student that belonged to a group where the interaction was dissatisfactory.

One student could fulfil more than one category (i.e. young female nursing student belonging to a group with well functioning interaction). The selection was based on the urge of getting a variation as great as possible representing opinions from as many different kinds of students as possible.
It was not aimed to compare people representing different categories with each other. The last two categories, where the interaction was satisfactory or dissatisfactory, were created as an to study what factors the students in the two groups believed influenced the interaction.

The students interviewed were also the only students that freely signed up for participating in the interviews. No selection of students was thereby made. The students attending the interviews were:

- One old male nursing student belonging to a group where the interaction was satisfactory.
- One young female nursing student belonging to a group where the interaction was satisfactory.
- One young male nursing student belonging to a group where the interaction was satisfactory.
- One older male social care student belonging to a group where the interaction was dissatisfactory.
- One older female social care student belonging to a group where the interaction was dissatisfactory.
- One young female medical student belonging to a group where the interaction was satisfactory.

**Facilitator**

The facilitators chosen for the interviews had to represent the following categories based on the subcategories created through observations:

- One facilitator guiding a group that interacted smoothly with EDIT.
- One facilitator guiding a group that interacted less smoothly with EDIT.
- One facilitator who controlled the students more.
- One facilitator who controlled the students less.

One facilitator could fulfil the criteria of more than one category. These categories were created to get as great variation as possible. Two facilitators were chosen randomly from the groups observed. The facilitators belonged to the following categories:

- One facilitator that practiced little control and guided a group that interacted smoothly with EDIT.
- One facilitator that practiced more control and guided a group that interacted less smoothly with EDIT.
4.3.2 Students’ views and opinions

None of the student groups were homogenous. They all included students with different opinions about EDIT. This is the reason why I refrained from presenting the individual data from the interviews with the students. The data presented represented the group as one unity attempting to reflect the variation of opinions of the students. The number of students interviewed was small, and their identity could be identified. That was also one reason why each student’s opinions were not presented individually. The quotations presented are the student’s own comments².

EDIT shows reality

One of the most unique and positive features of EDIT was, according to the students, its ability to bring reality in to the classroom. It was mainly the elements of multimedia, e.g. video clips, audio clips, pictures, photos etc. that according to the students seemed to create the realistic segments.

"EDIT is reality."

"Multimedia gives us the reality."

The multimedia segments, together with the rest of the information presented in a scenario, gave the students an overall picture of the patient. EDIT helped them to see things from the patient’s point of view and it stimulated different senses.

“…EDIT gives us an instant picture of the patient”

“We can see and hear people, the patients become real”

“EDIT creates feelings, it feels real…and it’s good since we often meet people in crises”

Most of the students argued that EDIT presents scenarios that are similar to the kind of problems that they will encounter in their future workplace. Some students argued that it was not only the multimedia elements that created realistic scenarios. Some of the students experienced the structure of the scenarios to be identical with a real patient’s journal, although with a bit more pedagogical approach.

² The quotations can not be considered as verbatim since the interviews were not recorded on tape and transcribed. They were written down and might differ slightly from what the interviewees said. They were also translated from Swedish to English, which in turn might have affected the meaning. They are still included since they are considered to give a reasonably true picture of what was said in the interviews.
“EDIT presents problems that might occur when we are out there working at the clinic”
“We work with the same information that will be available to us in our future workplace”

The reality aspect was an important difference when the students were asked to compare the difference between the paper based scenarios and the electronic scenarios. The authenticity of the electronic scenarios seemed to motivate the students in a way that the paper based scenarios could not do.

“EDIT makes it feel as if the scenario is about a real person.”
“EDIT is more realistic and more fun to work with…it stimulates my thinking and motivates me to study more, I really feel like I want to solve that patients problems. ”
“…the paper scenarios were so boring, just black and white… they didn’t have any support in reality.”

**EDIT’s influences on the learning process**

The students argued that EDIT influenced their way of studying and learning. The opinions were mainly positive as illustrated in the next section.

**EDIT as a group member**

The students felt that EDIT activated them and made them work as a team. EDIT forced the student to focus on the same thing, namely the screen where the scenario were presented.

“EDIT gives us a common focus. No one can hide behind the paper.”
“…people used to just do their own thing before. Now it’s more uniform even if each group works differently.”

On the surface, EDIT seemed to be a tool that the students used to gain essential information. The interviews showed, however, that EDIT had a more active role in their work. The majority of the students considered EDIT as an aid in their group collaboration. It was the basis for their discussions. The system did, according to the students, control the discussions in a positive manner.
“EDIT limits what we should work with...which is good...we could read everything otherwise.”

“We work as a team...EDIT is like a supervisor who collects all our thoughts:”

**EDIT’s influence on individual learning**

EDIT had also a role in the student’s studies outside of the group sessions. Some students used EDIT as a basis studying for exams. They argued that the EDIT scenario helped them to remember.

“... you remember the different scenarios through for example video clips...they can be too overacted so that they become funny... but you always remember the funny stuff...”

One student exemplified that a picture or a video clip of the patient made her remember the whole scenario.

“If someone tells you...’it’s the scenario where the lady spoke with such a strange voice’...you always remember the scenario and what we did to help that patient.”

The EDIT scenarios seemed to motivate and stimulate the students to study. It stimulated several senses, senses that they were not used to using in these learning situations.

“...EDIT makes me eager to learn...it is an extra spice, makes it all more fun.”

“It’s like watching a movie... you just want to know what will happen ‘what’s next what will happen next...?’“.

Most of the students agreed that EDIT helped them understand and to apply their theoretical knowledge.

“EDIT helps me understand the theories since theories have their roots in reality”

**Improved computer skills**

A final positive issue brought up by most of the students was that using technology as such in their education made them more prepared for the future demand on computer literacy. The students believed that they would be better prepared and more experienced with computers by working with EDIT. The use of technology was altogether experienced as an innovative part of education.
“EDIT makes the education more computerized... just like the hospitals are becoming nowadays... its great to get the experience!”

“EDIT gives me self esteem to work with computers.”

Factors that influence the interaction

The interviews showed that there are many different factors influencing the interaction between EDIT and the students.

**Personality and traits**

According to the interviewees, the attitude of students seems to be an important factor affecting their interaction with EDIT. They argued that there are always people who are conservative to all new things. As well as there are always people who are interested and enthusiastic towards new things. It seemed to be important that the system functioned well however, since a well functioning system spread a positive attitude about EDIT:

“...some people do always stay with the old other do always want the new...”

“It’s so important that the system functions, especially in the beginning... when the system is introduced... you can not rely on it if it doesn’t function ...and there are always people with negative attitudes ...they always complain when something goes wrong...”

Some students thought that biological traits such as gender and age could both directly and indirectly affect the interaction. Others students thought that these factors did not have any influence at all.

“The older students do usually have a more negative attitude...”

“I don’t think that age and gender do affect as much as interest does...”

**Technical skills**

It was especially the technical skills and technical experience that many students argue affected the interaction. Age and gender did in turn affect technical knowledge according to some of the students.

“Boys might generally have greater technical skills...”

“Technical experience is dependent on age, we younger students are usually more experienced with computers...”
The students agreed, independent of the influencing factors, that a high level of technical skills and experience was important when interacting with EDIT. They also agreed that there were large differences between the individual student’s technical skills. This was something that affected the interaction with EDIT. The students argued that:

“There should be a EDIT-driving license…”
“...some people fear using it…”
“we have to get used to the system…just like we got used to reading a paper…”

But it was not only the students’ technical skills that seemed to affect the interactions. Most of the students argued that the facilitator’s technical skills were very important for the interaction as well. Their technical knowledge as well as the amount of control and verbal activity affected the interaction according to the students. The facilitator was expected to solve all temporary technical problems. They were not supposed to control and interfere with the students’ work either. Some students disagreed about this opinion arguing that the facilitators were too passive and ought help them more especially concerning planning each session.

“It doesn’t give much confidence when a facilitator says ‘can someone help me start up this thing because I don’t know how to?’ What if no one can?’
“…the facilitator should help us to sum up what we ought to do each time....”
“…the facilitators role is important…they should have technical skills and only a small verbal part…”

**Design**
Finally, the design of the system is an affecting factor according to the students. Some students complained about the quality of the multimedia. It hindered them from interacting fully with the system.

“The video clips had bad quality…I couldn’t see or hear what they said”
“The multimedia makes it too concrete sometimes…it doesn't give us the space to test our own knowledge.”

Another factor that hindered some was the structure of the scenarios. They were sometimes too deep and contained too much information to process. But the scenarios could also be too shallow and not contain enough information. The shallow scenarios did not according to the students give
them the right inspiration. Although one student pointed out that she was very pleased with the scenarios:

“The more information the bigger the overall picture…”
“…the information load isn’t a burden, it’s more like a challenge.”

Most of the students stressed that each group had its own way of working with EDIT and some problems might because of that be more problematic for specific groups. One thing however, that hindered all of them in their interaction was the design of the system. The students experienced that one of them, the one navigating and the writing, was left outside the group.

“Writing and navigating makes you end up outside the group.”
“I fall behind and I miss my chance to test my knowledge.”
“…I don’t have time to make any notes.”
“…it’s like the one writing leaves the group he’s not part of the discussion…”

Some students used the whiteboard or smart boards when they wrote notes together in the group. They saw problems with the interaction using these artifacts.

“…the one who writes on the board becomes like a teacher who only writes down what the group says…”
“We spend so much time writing…I just want to think and say the word at once…”
[Says a student who belongs to a group who uses a regular whiteboard when they do the different PBL steps. The text written on the board can not be saved and the students have to write it down on paper so that they can work with it later]
“We used the smart board in the beginning but it was too hard to use and contained to many functions, so we used a regular whiteboard instead.”

A couple of students did also stress that EDIT forced students to do everything simultaneously in the group. Everything was visually available to everybody at the same time.

“I read slowly…the others read quicker than me and it’s hard…”
“…it’s hard if you are in charge of the writing and people pick on your spelling…”
Some students experienced the milieu as an impediment for the interaction. Some students had complaints about e.g. their session room. It was too small and it was hard to fit all the students. Others complained that the access to university computers was limited. The idea of accessing the computers whenever wherever was however experienced as a great thing for the interaction.

“...you can’t expect that everyone has a computer and Internet in their homes…”
“...there’s never any computers available...they are always occupied..”

**Changes to improve the interaction**

The students were given a chance to come up with suggestions of how EDIT could be improved. The students seemed to have a lot of ideas for improvements. Most of them suggested that the students need to get more experienced using EDIT.

“EDIT doesn’t suit everyone…it should be introduced in stages, maybe earlier during the first semester…”
“... use only one system, use only EDIT...people will get used to it then.”
“We should be more prepared... I didn’t get any introduction before I started working with EDIT...I didn’t even know what it was when I saw it the first time…”
“...there should be enough computers at school so that people can access it by themselves, between the sessions.”.
“Educate the facilitators so that they can handle the technology properly.”
“Teach everyone how to use the different software…”

The students have a lot of opinions about EDIT and the scenarios. Some of the students wanted EDIT more properly evaluated, to improve the design.

“The scenarios are evaluated too poorly. I just adjust to it and I don’t question things that much.”
“Add more steps and elements to the scenarios...the reality isn’t always as simple and easy as some of the scenarios are.”
“... increase the focus on the purpose of each scenario.”
Some students wanted to improve the multimedia functions.

“I want more video clips, they are fun.”
“Use real actors in the videos…do them more professional”
“Combine video and text…the video shows the acting while the text would summarize what has happened.”
“Improve the quality of the picture and sound.”
“I have a little problem understanding Swedish…it would be great if the video clips could be sub-titled so that it would be easier to understand.”

Some of the students missed the ability to print the scenarios or the text that were produced during the sessions.

“It’s so hard to get access to computers when I need one so I have to print everything…”
“It’s too bad we can’t print what we write on the whiteboard…it’s stuff that would be great to have when studying for exams.”

4.3.2 Facilitators’ views and opinions

The results from the interviews with the facilitators are presented in the same way as those of the students. The quotations presented are the facilitator’s own comments. They are however translated from Swedish to English, which in turn might slightly affect the meaning of the original quotations.

The role of the facilitator

The interviewees were pretty unanimous when asked about their role in the interaction. They argued that one of the roles was to facilitate learning. There were however many things that the facilitators need to control to facilitate learning.

“…we must facilitate the different processes that occur in the group.”
“…we should facilitate learning through structuring and setting limits…”
“…be vigilant to interrupting elements that could restrain learning.”
Another area of concern for the facilitators was their responsibility of technology. They argued that their knowledge was important for the interaction.

“We are responsible the technology to work well.”

“It is important that the facilitators know the technology, it becomes an interrupting element otherwise.”

“We miss out focusing on the group processes when the technology fails.”

“The technology has to function if EDIT is to function.”

“We had to prolong the sessions since we had so much trouble with the technology…”

A final important issue was, according to the facilitators, the control that the facilitators practiced. They had to know when they should or should not interrupt and control the students. One of the facilitators stressed that the facilitator could be a resource for the students although not during the sessions. The facilitators should also ask meta cognitive questions as well as evaluate and assess both students and the whole group.

The demands for EDIT to work well

There are demands on both students and facilitators to get the interaction between students and EDIT to function well. The demands on the students were, according to the facilitators, to keep the agreements that the group had made. One agreement could for example be:

“…they have to keep our agreement – don’t peek on the scenarios in advance.”

Another agreement for the students was to be responsible for their own studies. It was important though that they worked as a group, shared their knowledge, discussed and generated questions. One further demand, as pointed out by one of the facilitators, was that the students should have the possibility to get familiar with EDIT. The interaction would otherwise not work well. Both of the facilitators agreed however that they also had demands towards themselves. The main demand was that the facilitator had to be present (not only physically) at the sessions.

“I have to be present…the whole of me has to be there, for them, the whole time.”
It was also very important for the facilitators to trust both the technology and the method of pedagogy, to be able to fulfil their undertakings and to avoid interfering the interaction.

**Changes to improve the interaction**

The facilitators interviewed did come up with some ideas of how to improve the interaction between EDIT and the students. They argued that more support was needed.

“I would like more feedback from others than the students regarding my role as an facilitators. The facilitators could visit each others groups for example and give each other feedback.”

“I would like to have more contact with the creators of the scenarios so that I get a better understanding of the scenarios and know what kind of hint questions to ask the students and when.”

“More technical support is needed…”

The students also need more support especially concerning learning and getting used to working with EDIT.

“…you don’t have to discover the wheel each semester. Older students who have worked with the technology could help out by showing the new students some hints and well needed functions”.

The facilitators wanted to improve the design of EDIT to amend the interaction. The quality of the presented material ought to be improved. The quality of videos and sound should be improved as well as the content of the scenarios. Some of them were too controlled. Some of the graphics, pictures and photos needed, according to one of the facilitators, further instructions on how they should be interpreted. There were other suggestions concerning the milieu and design that also need improvement to increase the interaction.

“…place EDIT in the middle of the group so that everybody can see it and be active…”

“…you miss too much if you miss one single session.”

“The one who is writing is always outside of the group…”

“It’s not a failure to use paper …some students like using paper.”
4.4 Discussing findings of areas that need to be improved

Some critical issues needed to be raised before the discussion. All of the students who showed interest were also included in the study. These students were in general students with mostly positive opinions about EDIT and who also had the skills to use EDIT properly. Most of them did however criticize EDIT. It can however not be excluded that students with negative attitudes and who did not have the proper skills to use EDIT, would have generated interesting data that could have been valuable for this study. It should also be stressed that there were high numbers of male students involved in the interviews in comparison to distribution according gender at the different study programs observed. This was a variable that was hard to control since no other students were interested in participating in this study.

There were also factors in the design process that affected the interaction, that were hard to control for. Such factors could include e.g. the group constellations and peoples’ attitude towards the system. It was not feasible to group the students by matching their personalities or skills. Positive attitudes or positive opinions about EDIT could neither be forced on to people. There were however improvements to be made that could decrease the negative attitudes and the amount of problems that occurred in the groups.

4.4.1 Catering for diversity

Diversity among the university students is not rare nowadays, it is the reality (Gilliani 2000, Koschmann in press). Koschmann (in press), Gilliani (2000) and other authors argue that diversity is something that ought to be taken into consideration when educational tools are developed, designed and applied. This ought to be included more thoroughly in the design of EDIT as well. An example taken from the data collection was a student with non-Swedish background, who requested subtitled video clips so that he could understand the dialogue more easily. That is one example of lacking consideration to the diversity among students. Even if Swedish is the main language of teaching, this student sought help with his understanding of the video. A subtitled video clip could not only help him but other students as well who had trouble hearing and understanding what was said.
Diversity among students

The diversity among students was obvious in the different student groups. The students’ computer skills varied a lot, which affected the interaction. The groups that had one or more students with good or advanced computer skills, seemed to handle the technology well. These groups had students who took care of both simple as well as difficult technical problems that the group encountered. But groups lacking the persons possessing these skills had greater trouble solving gentle technological problems. This implies that the general level of technological skills has to be improved among all students. The students argued that the only way to do this was to get more experience in using EDIT. But this seemed hard for the students. Two student groups were for example not given personal logins. They were, due to this, not able to access EDIT outside of the session rooms. Theses students might have become more experienced and more familiar to EDIT if they had had the chance to try EDIT by themselves, in their own pace. It was hard for those students who did not have access to neither Internet nor a computer at home as well. There were, according to the students, rarely any computers available at the university. The lack of technology made it even harder for the students to get any experience in using EDIT at any other time than during the sessions. The knowledge about how to use EDIT should not become a matter of the student’s economical ability to own a computer. Research by Koschmann (in press) and Margolis (2000) show how high income students use technology in a more innovative way than lower income students. This is something that should be counteracted by giving every student the same chance to learn how to use EDIT. A solution would be to increase the numbers of computers or reserve a couple of them for EDIT use only. The computers should be available to all of the students located at different campuses or buildings. Altogether, more effort should be put in introducing EDIT better to its users. The fact that some students did not know what EDIT was the first time they used it, implied a great need to improve the way the technology is introduced. The introductory lectures that were given (if they were given) should be complemented with tutorials. The students ought to get a chance to, in their own pace, test the system and equipment that they are required to use. They should be fairly experienced with EDIT before actually using it as a part of their studies. One of the facilitators did in the interview suggest “it is unnecessary to invent the wheel each semester”. More experienced students could help the new students learn how to use the system by giving them hints and advise.
4.4.2 EDIT and the working environment

The physical placement of EDIT and the surrounding artefacts were, according to the data, particularly important for the interaction. It seemed like some of the milieus were not suited for EDIT and the groups of students. The rooms were too small for four of the student groups observed. The students interviewed also confirmed this. Students did complain about physical problems such as headache or problems with concentration due to the technology and its placement. These are issues that need to be taken into consideration. Just rearranging the rooms and the placement of the technology could solve some of these problems. The working environment should not hinder the students when they work with the EDIT.

4.4.3 Improve and innovate

It was very important that the students and facilitators had trust in EDIT. Too many problems did however jeopardize the trust and created a lot of negative attitudes towards EDIT. Some students complained about the quality of the sound and picture on the video clips. Others complained about not being able to access some text files or video clips from home. These were problems that could have been solved easily; the video player on the computer had to be upgraded to improve the quality of the video clip. And more information to students about required software (e.g. that the needed software was available for free on the Internet) would have solved their problems with not being able to access certain information at home. These simple and easily solved problems caused large problems for the students, jeopardizing their trust in EDIT. The unique feature of EDIT seemed, according to the students and the observations, to be its ability to bring realism into the classroom. That is an additional reason why it is important that the multimedia elements function properly.

The developers of EDIT have succeeded in using new technology to create the scenarios in the way Laurillard (1997) and Koschmann (in press) argues that they ought to be. They have created ill-structured and complex scenarios with the help of multimedia elements and PBL pedagogy. They have succeeded in creating scenarios that the students consider authentic. The students enjoyed the multimedia features as far as they functioned properly. The positive attitudes are something that the creators should take care of when developing EDIT further. A couple of students wanted more videos, while other students sought more guidance on how to interpret graphics and pictures.
The observations and interviews showed altogether that there were a lot of opinions and ideas among both students and facilitators. This next chapter will give suggestions on how EDIT can be improved.
5.0 Redesigning EDIT to improve the interaction

This chapter will focus on one specific area that needs to be improved. All of the areas presented above could also be researched further, but it was not possible with in the framework of this study. The area selected for further research was the design of EDIT and especially the design of the different technological modules used, that create EDIT. The aim with this part of the study was to come up with a design solution that would improve the interaction between the students and EDIT. The design process started with by identifying the problem and thereafter formulate the design goals. A literature review was also made as a basis for the new design solutions. The solutions were thereafter tested on users through user analysis. The user opinions and comments were analysed and thereafter discussed and will be presented at the end of this thesis. The ideas were however never implemented. They were only made visible through simple low fidelity-prototypes.

5.1 Describing the area of problem

EDIT was supposed to be designed as a groupware to suit a tutorial group of about 6-10 users. The main concern about EDIT’s design is that the whole system is based on technological input devices designed for single a user only, that is for instance one mouse and one keyboard.
The system can only be operated by one of the 6-10 students. This design puts the operator in a difficult position. The students argue that they, when being operators, cannot test their own knowledge or contribute to the discussion. They have to concentration on the interaction with EDIT rather than on the collaboration with their peers.

![Image](image.png)

**Picture 4. Shows how the student active by the board has to leave the group to be able to use the board.**

The design did also become an obstacle for the students when they applied the PBL steps. The problems with software like MS Word that does not support the whole PBL cycle, has previously been mentioned. Some students did also argue that a person who was not skilled enough to handle the interaction, hinder the group processes. Students belonging to groups using smart boards or whiteboards argued that the boards could be ineffective. The students using regular whiteboards did for example lack the possibility to save notes written on the board. The board’s restrictions made the notes inaccessible for later studies. Furthermore, it bothered the students that one student always had to leave the table to write on the board. A couple of students argued that this particular student received the role as a teacher. The “teacher” stood in front of the other students and did not act as a member of the student group. These problems tend to violate the fundamental ideas of PBL where students are anticipated to take responsibility for their studies and be able to test their knowledge and gain answers to their inquiries. According to some students, it was difficult to
have the role of a writer and navigator at the same time as trying to be a student and participate in the learning process.

To summarize, the problem seemed to be that the system was not fully designed to suit multiple users in a PBL curriculum. The following part of this chapter will discuss this problem a bit further. A theoretical background will be given as well as suggestions on how these problems could be solved.

5.2 Design goals
The main idea and objective of the redesign process was to achieve an improvement of the interaction between the students and EDIT in an educational setting based on PBL. The goal was thus not to create a totally new system. The design was based on the concept of having scenarios presented through the World Wide Web. The fundamental design goals were the following:

- **Increase the number of users interacting with EDIT.**
  Improve the collaboration so that the each students could take part both in the discussions and the interaction.
- **Support PBL**
  EDIT should support all the steps of the PBL cycle.
- **Reduce the influence of differences between students’ computer skills**
  The differences between the students’ computer skills should not be decisive for the group’s ability to interact with EDIT. A redesign of the system has to decrease the reliance on the student’s technological skills.

5.3 Design problems and solutions
The fundamental design goals became the basis for the whole design process. Some of the solutions might appear as non-viable but they are presented here as suggestions for future improvements. They might not be viable today but might generate new ideas and solutions to some of the existing problems. The solutions to each basic goal will be presented one by one followed by suggestions of coherent systems.
5.3.1 Increase the number of users interacting with EDIT.

One of the major problems with EDIT was that only one student at a time could interact with EDIT. It ought to be a groupware designed for multiple users but could only be operated by a single user.

Single Display Groupware

One area of application in the area of Computer Supported Cooperative Work (CSCW) is Single Display Groupware (SDG). SDG is defined as a class of CSCW application “that enables co-present users to collaborate via a shared computer with a single shared display and simultaneous use of input” (Bederson et al 1999 p.1). SDG differs from groupware, that usually presupposes that the users work together while located in different rooms. Although SDGs are widely used for commercial purposes, there is still great need for further research in the field of CSCW.

Characteristics of SGD

There are some characteristic features that define Single Display Groupware applications. They are according to Bederson et al (1999, p.7):

- Shared Space
- Coupled Navigation
- Shared User Interfaces
- Shared Feedback
- Shoulder-to-Shoulder Interaction

SDG are designed so that the users view the same screen at the same time. The users do therefore view the same visual screen components in the same environment (Greenberg and Zanella 1999). There are systems nowadays that can be defined as SDGs. They are usually computers hooked up to a projector that projects the picture from the computer screen on a larger screen. The larger screen makes it possible for a group of people to view the information presented on the computer screen. EDIT is an example of that. EDIT is a system that consist of a personal computer that is hooked up to the Internet but also to a projector that projects the information on the computer screen on a whiteboard or smart board. The students using EDIT view the same screen, together, when located in the same room. But EDIT does not fit Bederson et al’s definition of SDG. EDIT is not designed with Multiple Input Devices (MID).
Lack of MID

The first Personal Computer (PC) was created in the early 1970’s at Xerox PARC. It was designed with the assumption that only a single user would sit in front of it interacting with the system at any given time. That is why the computer was designed with a single mouse and keyboard. Thirty years later, the fundamental design assumptions still remain that is PCs are only designed to be used by a single user at any given time (Benderson et. al. 1999). The design of PCs does consequently cause trouble when PCs are used as SDGs. The main general problem is that the input device has to be shared and the users have to take turns to use it. This can be very difficult and awkward for the users when they try to cooperate and interact with the system (Greenberg and Zanella 1999).

Research shows that the characteristics of the computer tool used are susceptible to influence the modes of collaboration adopted (Golay et. al. 2000). Research results show for example that single input devices change the notion of who is in control. The operator of the mouse and keyboard, in a group setting, is found not to be in charge of the interaction (Stewart et al 1998, Greenberg and Zanella 1999). Greenberg and Zanella (1999) found in their study that the operator usually follows orders requested by the surrounding users. The operator has control only when the passive users are busy with other things and not focused on the interaction. Stewart et al (1998) found in their comparison of children using single and multiple input devices respectively, that the children using single input devices fought to control the device. The passive child was irritated by not being an equal participant in the collaboration. The study showed also that the passive users tended to be in attentive and they did not stay focused through out the whole task. The quality of communication was also found less collaborative. It was mainly the passive student issuing orders to the active partner (Stewart et al 1998). The consequence of using single user technology in a group setting was, in the Stewart et al study that it lead to unwanted conflicts or tension between the children. The conflict and tension was accordingly caused by unequal control over the application and unequal participation in the task (Stewart et al 1998, Arvola 1999).

Ellis et al (1993) study as well as both Stewart et al’s and Greenberg and Zanella’s studies show that using multiple device groupware improves the users’ ability to collaborate and interact with the technology.
Solution

There is a lot of resemblance between EDIT and the results from these studies presented. EDIT generates the same kinds of problems for the operator as for the operators in Stewart et al’s and Zanella and Greeberg’s studies. The operator mainly follows orders from other students and have not much opportunity to collaborate while interacting. Some students in the interviews expressed frustration when the operating student could not handle the equipment and interact well. This resembles with frustration expressed by the passive children in Stewart et al’s study. The data collection showed also that the only time the student operating EDIT interacts freely was when the rest of the group did something else. An example was when the operator emailed the created documents to each student while the rest of the group did an evaluation of the achievements during the session. These findings resembled the results from Greenberg and Zanella’s research as well.

The solution would be to increase the number of input devices. The problem though is that the scenarios are presented through a web page. It can therefore be hard for the students to navigate a page together, since the page could only execute one command at the same time. A solution could be to let each students have their own screen to navigate, in analogy to the paper based scenarios. But this might cause the same effects that the paper based scenarios did, that is the students would lack a common focus which would complicate the collaboration. I do not consider navigation as a severe problem that hinders the interaction. Navigation is not to be considered as a difficulty if the web page is well designed. I have therefore based my design solutions on single input device for navigation. Multiple mice could however be provided so that the role as a navigator could easily be changed during the session.

The input device for writing was also an obstacle for the interaction. Each group, no matter which technology they used, had problems with not being able to interact with EDIT during the writing parts of the PBL process. The solution would be to enable for each student to interact with EDIT and contribute with their thoughts and notes without being dependent on other students. One solution would be to let each student have his or her own input device. One option could be to let each student have his or her own electronic pen and sketchpad to write on. The word they wrote would pop up on the screen visible for the whole group. The problem would occur when reaching the grouping phase when words are put together in related groups. Problems would occur when 10 students interact and group the
words at the same time. Especially if each input device lacked a specific marker to identify the operator.

5.3.2 Support PBL

One important aspect when introducing educational technology in a learning environment is that the technology supports the theories about learning (Koschmann in press). EDIT should be designed to support PBL, which it does not fully do today.

Software

One of the issues discussed previously was the fact that software like Microsoft Word did not enable students to work with each step of the PBL cycle. The system software should enable the students to both write and draw, but also to group written concepts or words. This can be done through using a whiteboard that indeed are recognized as good tools that supports collaboration as well.

SDG using whiteboards

An important element in SDG is the single display that the users view when they interact with the SDG technology. Using different kind of boards has become more and more common. One kind of boards is whiteboards, regular or more technologically advanced as the smart boards used by some of the EDIT-students. The whiteboard is usually used to take quick notes, organize infant ideas, sketching diagrams etc (Igarashi et al 1999). They are effective for people working collaboratively since it can contain large collection of information. It is an artifact that enables a group of people to view, annotate and organize information collaboratively (Guimbretière et al 2001). It is also a good tool to improve communication when discussing something with one or more persons. The fact that it is physically present and has an informal writing interface does also lead to quite different characteristic usage styles when compared to standard desktop systems (Igarashi et al.1999). A regular whiteboard does for example lack the ability to save what has been written on it (Guimbretière et al 2001). Although the development and availability of effective whiteboards is increasing, they still are very costly.

Support learning - enabling life long learning

The students produced a lot of new knowledge as they worked with the scenarios. But those who used regular whiteboard as an aid for writing down notes and sketches were not able to save what they produced. This does not support learning since the students are not able to bring home any
notes that would help them acquire and acquire new knowledge. The solution would be to use an application that would make it possible for the students to save the notes that they produce.

**Software for interactive whiteboards**

An early study in 1987 by Stefik et al enabled multiple users to simultaneously interact with a whiteboard. The application Tivoli was used as the first well-developed electronic whiteboard system. The user could interact with Tivoli both remotely and co-presently. The simultaneous use of the whiteboard was however never observed. The lack of adequate software level for co-present collaboration might according to the authors have been the reason to that. The research for proper software has developed through the years. There are different projects that concern this area of interest. One of them is Flatland. Flatland is an augmented whiteboard designed to assist the informal activities that might occur in an office environment. The research has especially focused on persistent strokes on the board. Flatland “supports the use of independent clusters of strokes, how specific computational support is applied to each cluster, and how strokes on the surface is recorded and retrieved” (Igarashi et al 1999 p.1). The Flatland prototype system has been tested on Xerox Liveboards and front projected smart boards (ibid). Guimbretière et al (2001) is another group of researchers that have come up with an interactive brainstorming tool. They have used a “interactive wall” metaphor guiding several goals of the design goals: “to support free-hand sketching and high resolution materials, such as images, 3D models and GUI application windows; to present a visual appearance that does not clutter the content with control devices; and to support fluid interaction, which minimizes the amount of attention demanded and interruption due to the mechanics of the interface” (Guimbretière et al 2001 p.1). The system brings together the advantages of both whiteboards and graphical user interfaces. It allows the user to work with computer based materials including both arbitrary applications as well as 3D models, with the ease of informal writing, sketching and space management (ibid.). These are examples of research that aims at developing new ways of collaboratively interacting with information.

**Support small group collaboration**

To summarize the discussion this far; EDIT needs to enable all the steps of the PBL process, but also to make it possible to assist the students in their way of life long learning. Whiteboards are great tools for enabling all the PBL steps but they do not however enable the students to save their notes. Interactive whiteboards such as smart boards do enable this and they do fulfil both of these criteria. But using interactive whiteboards in the context
of EDIT also forces one student to leave the group and become the “operating device” between the student group and the board. This does not agree with PBL, where all the students should be able to participate and test their knowledge and learn for life. One solution would be to use whiteboards placed on the table in front of the students instead of the wall. The interactive whiteboard could be placed so that the students work mainly around the table. This enables face-to-face communication and collaboration between all the students without forcing anyone to being excluded from the group. The board would be designed as a mobile board or as an interactive table. This kind of design would support PBL. Proper software would make it possible for the students to save their notes.

5.3.3 Decrease the effects of the differences between students’ computer skills

The last fundamental design goal was to reduce the differences between the student’s computer skills. One improvement that could be made is to avoid the situation with one single student being responsible for the whole groups’ interaction. The solutions mentioned above, that is increasing the number of students interacting with EDIT, would probably make the non experienced users less exposed and frightened of using the system.

5.4 Design alternatives

Four solutions were selected to be presented for the students attending the user analysis. The solutions were based on the basic design goals presented previously. The solutions were similar in many ways. All of the four suggestions consisted of some fundamental features; The scenarios are projected on a large wallbased screen hereafter referred to as the large screen. The projector enables the students to change what is to be presented on the large screen. It could either be the scenario or a slide of the interactive board that the students write on. This makes it possible for a student to view the scenario and to work with the interactive writing area at the same time. The students can interact with the scenario by using one or more cordless mice. This is not an optimal solution, but it is hard to navigate a web page with multiple controls, as stated previously. The main improvement is that any student sitting around the table could use it without needing to move from their seat. All of the suggestions are thereby considered as single displayed groupware. The main difference between them is the interactive areas that the students are supposed to takes notes on. The designs concern the “physical” technology that creates EDIT. It should be stressed that software for these design solutions might not be available. But as Flatland and the other examples show, software will
probably exist in a near future. The redesign suggestions are however the following four:

5.4.1 A mobile small sized interactive whiteboard.

A mobile small sized interactive whiteboard enables such functions as saving written notes and moving around chunks of text or symbols with your own finger as input devices. The surface can be written on with an electronic pen. The text appears on the surface in different colours depending on which pen the user uses. The students view the written text straight on the interactive whiteboard and/or on the screen. The mobile capability makes it possible to use the table for different purposes. The negative effect is that all of the students can not write on the small sized board at the same time. The board is however easy to move around on the table.

Mobile interactive whiteboards like the one suggested are not yet available on the market. The only interactive whiteboards that seems to be available are large boards like the ones already in use at the University. These boards may cost more than 20 000 SEK. There are however smaller sized displays available on the market that are 1292
mm*826 mm (Numonics 2002). These screens are however not designed to be written on.

### 5.4.2 Interactive Table

![Figure 4. Design suggestion 2, the interactive table.](image)

The table in design suggestion 2 would contain the same qualities as the mobile interactive whiteboard. The idea of only using one table makes it possible for each student to interact and to be a part of the interaction. This design would however require software that can handle text written up side down and from different directions.

Tables like these are not either available on the market. The price for a table like the one suggested is therefore very hard to estimate.
5.4.3 Table with a certain interactive area

A third solution would be an interactive table that would contain some non-interactive areas as well as an interactive area. The table would allow the students to lean on the table or put books on it without disturbing the interaction.

Tables like these are not yet available on the market. Research is however made on tables with similar design at for example Stanford University, USA (Stanford 2002) and DSV, Sweden (DSV 2002). The price of such tables is however hard to estimate.
5.4.4 Multiple interactive screens/pads

Figure 6. Design suggestion 4, individual screens or pads.

A fourth solution was to give each student his or her own area to write on such as a pad or screen. This design might create a clutter and it might also cause the paper based scenario effect that is lack of common focus. It seems hard to have ten pointers or markers that for example have to rearrange words into proper groups. This would probably lead to a situation with only one or a few students being able to control the interaction, which would cause the same problems that already exist today.

A system like this requires different kind of technology. Interactive computer screens are available but will be costly if as many as 8-10 in each room are needed. A pad connected to a computer is also available on the market. To my knowledge it is not clear if it is possible to connect the screens or pads to a system with multiple users in the way suggested above.
5.4.5 Homepage for each tutorial group

It is obvious that all four systems would generate a lot of document files. The solution would be to create a homepage for each student group. The web page would be accessible for the students and their facilitators but also for the faculty members. It would contain a joint email address that reaches each group member’s personal email account. The files that are created during the sessions could be saved on the page and thereby be easily downloaded. This would give the students easy access to their notes but it would also make it easy for creators of the scenarios and faculty members to view what the students achieve during the sessions. It would also be possible to have electronic evaluations of scenarios, groups or other things concerning EDIT, that are needed to be evaluated and improved. This vision was also presented for each user during the analysis.

5.5 User analysis

The users are the persons that use the system. They therefore possess the knowledge about the interaction between them and EDIT. The four solutions needed to be tested on the users and their opinions and ideas were thereafter taken into consideration in the design process.

5.5.1 Methods and selection criteria

The aims with the user test were to get the user’s opinion about my design solutions but also to get higher validity. That is to get an opinion from the users that the ideas and redesigns were legitimate and not a misinterpretation. The goal was to create a focus group of users, that meet up and discuss the solutions together as a group. Focus groups are an effective way to test ideas that the designer has formed. They may provide the designer with significant insight into the users perception, and it does also give the users a chance to add ideas and opinions to the solutions presented (Hackos and Redish 1998, Rothe, P. 2000). An attempt was made to create a focus group consisting of students from the different programs and groups observed. The attempt was unsuccessful since it was impossible to find a meeting date that suited all of the students. It resulted in interviews made individually with each student. The students picked for the study were students who belonged to the groups observed. The students were contacted by email. Four students showed interest in participating in this part of the study. One student was however not able to attend when it was time to carry out the tests. The amount of three users was admittedly small. But also this small number gave valuable information on the
students’ opinions on the design suggestions, even if their representativeness remains uncertain.

The tests began with a brief presentation of what the study was about and what had been found so far. The students had thereafter a chance to comment the ideas and to come up with own solutions to the presented problems. The four design solutions were thereafter presented to the students as basic low fidelity-prototypes, identical with figures 3 - 6 presented previously. The ideas were also explained to the student so that the student could get a deeper understanding of the meaning of the prototype. A discussion between the designer and the student was held the whole time and notes about the users opinions were noted. A fair copy of the discussions was made immediately after each test.

5.5.2 User opinions

The user test started up with the students having a chance to give their own ideas of how to solve the problems presented to them. Only two students came up with an innovative idea, that was to use a speech recognition system like a Dictaphone. One of the students did explain the ideas a bit further. The idea was based on a program that could recognize speech and translate it to written text. The words would pop up on the large screen. The system would be combined with a program that could enable sorting of the words.

The four design solutions were thereafter presented for the students. The students expressed positive opinions but were aware of that the suggestions would be expensive to implement in reality. One student argued that the mobile whiteboard would be the one the faculty would buy since it would probably be the cheapest and most adaptable to the poor furniture that is used today. The students did however argue that the mobile whiteboard would not suit larger groups than up to 6-7 persons. One student said:

“EDIT’s design today shuts out one person while the mobile would probably shut out even more students”.

The fourth suggestion was also criticized. Especially by one student who thought that a the system would support individual work rather than collaboration. The students did overall seem to prefer the interactive table. The interactive table was popular since it provided space to write on. It was important for the students that everyone could see each other throughout
the whole session. It was also good that all students could participate in the
interaction. One student argued that a interactive table would create a more
familiar situation and natural behavior when it was made possible for the
user to use a pen and something to write on. It was also important for the
students to be able to lean on the table without interfering with the
interaction. One student suggested that the interactive area could be
delimited so that the students could get an own area to write on or that
different assignments could be divided to certain areas of the table. One
student did also suggest that a voice steered application could be connected
to the system so that it would be easy for the students to change between
the different windows (that is the scenario and the interactive area) as they
work.

Some questions were however raised concerning the technology. The
technology would altogether be fun to use but might not be needed
according to two of the users. One of them questioned the fact that the
suggestions are based on advanced technology that might scare and deter
the ones that do not like technology and have negative attitude towards new
things. The other student argued that the advanced interactivity (that is
being able to interact with the written text or drawings) is an unnecessary
feature. The student had belonged to a group that used smart boards. The
student argued that the interactive feature demands too much of each user.
It takes too much time to reach the proper level of skills until the usage of
the board flows smoothly.

The idea of a group web page was also presented to each student. They did
only have positive comments concerning the idea and one student did even
think that it would make EDIT more uniform. EDIT would not just consist
of a web page and different technology. EDIT would be experienced like
one system rather than different connected systems. The usage of a mouse
and keyboard when navigating did not seem to be a problem for the users.
To sum up, it can be stated that all of the students argued that the ideas
presented were good and could evolve into a well functioning system if
developed further, but that they saw potential drawbacks and complications
with them too.

5.5.3 Final solutions

The user analysis showed that the students liked the ideas presented to
them. They seemed to appreciate designs that made each student participate
in both the collaboration and interaction. Design suggestions one and four
did not fully fulfil theses criteria. Suggestion number one would exclude
users since only a few could use the mobile whiteboard at the same time.
Suggestion number four would be the opposite, all of the users could use it but only from their own pads or screens. This would not support group collaboration. The students argued that they would get too focused using the technology in front of them instead of focusing on the collaboration and the group.

The most approved suggestions would be the combination of suggestion two and three, the interactive table. The students liked the idea of using this table. It would make it possible for each student to participate in the interaction by using his or her own input device. This would probably decrease the influence of student control and improve the interaction as shown by Stewart et al (1998) and Greenberg and Zanella (1999). An interactive table would enable the students to see each other throughout the sessions. Each student could have a pen and be able to participate in the discussion verbally but also interactively.

The usage of an interactive table might also improve the communication between the members of the group. As Guimbretière et al (2001) argues, a whiteboard makes it easier to communicate between people in a group. It makes it possible for all of the students to contribute with ideas, without anyone leaving the group.

This design might also give all the students a chance to work equally with EDIT. This design is similar to a regular pen and paper. The input devices function like a pen and the board as paper. There are no keyboards, joysticks or other input devices that are unfamiliar to the students. They just have to use pen and paper as they have always done. The fact that each student has access to a pen makes it less stressful for the person writing since everybody can contribute as much as he/she wants. The system is thereby not dependent on any specific student and his or her knowledge and experience with computers.

The fact that some students criticized the interactive feature needs in my opinion to be discussed further. The students raise an important fundamental question in technological development. The question of what is really needed, is very important. They suggested that interactivity would make some of the work easier and more fun but only if everybody knows how to use the technology. To rely on advanced technology of this kind might create more negative than positive outcome. It might once again cause a need for more education for those who do not have the proper knowledge. This might in turn make the ones with the knowledge more active while the ones who do not have the knowledge remain more passive. This would lead us back to square one. The skill level amongst the students
might become more equal by removing the more complicated elements of the interaction. The ability to move the written word is a great thing for improving all of the PBL steps. But still, it is not impossible to manage without this feature. The most important interactive feature is according to the students that the created documents can be printed and sent to the students so that they can use them when preparing for exams.

The vision of creating a web page for each student group would support this wish. It would make it easier for the students to access the information needed. This vision requires however that access to computers and Internet should be increased all over the university especially in those areas where students spend time working with the scenarios.

Summarizing the analysis, the results and the discussion showed that EDIT should be designed for the whole group. The technology does not need to include the most advanced interactive functions. It is important that the system supports face-to-face collaboration. It was also considered important that the notes were possible to save not only in the students’ heads but also in an electronic document. An interactive table would be one solution. These ideas can however be developed further.

### 5.6 How realistic suggestions?

What can be done to improve EDIT in the future? But let us look at the future development of the main focus of this study namely the redesign of EDIT. The final design solution might seem like a non-viable suggestion today. But there is research going on in the area of interactive rooms and furniture. An interactive table that was suggested exists, even if it is not available on the market yet. One of the research projects that concern this kind of technological solution is called ispace. It is a project in progress at both Stanford University in USA (Stanford 2002) as well as at DSV in Stockholm, Sweden (DSV 2002). They work with new technology that supports learning. They are for example studying how different technologies can be integrated in a regular room as an attempt to create holistic interaction. One of the technological solutions that the Swedish group is working with is an interactive table. The table includes a table, with the a computer placed in the middle of it. The computer screen is placed horizontally as a part of the surface of the table. The table is interactive in the sense that the users can interact with the information on the screen by using a mouse and/or keyboard or by touching and writing on the screen. The users are able to work face-to-face with the same information without any body leaving the group. The research at DSV also

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3 Please visit [http://www.dsv.su.se/fuse](http://www.dsv.su.se/fuse) to view pictures of the table
concern how information, produced and processed around the table, can be saved and later used somewhere else in another setting including other technology. This is just one example of a research project that focuses on the same kind of problems that the existing design of EDIT generates.

An interactive table like the one developed in the ispace project will not be available on the market at a moderate price in the near future. A suggestion that might be more cost-efficient is to make a thorough investigation of the technology that is already available on the market. One possible solution on the problems might be the construction of a table by connecting different modules to each other. E.g. cameras could be connected to a small sized whiteboard that makes it possible to take photos of the writings and drawings on the board. Technology like this is already available on the market (E-beam 2002) for wall based whiteboards and costs about 5000 SEK. It takes a picture of the whiteboard (boards up to 2*1.3 m) and makes it possible to save this as a file on the computer. This solution does not create an interactive whiteboard. That was not either the students' greatest wish. It was to be able to save what they wrote on the board. Cameras like these make it possible for students to save their ideas not only in their heads but also on paper. Many of the previously presented design problems could however be solved if these cameras could be placed on regular small sized mobile whiteboards.

There are a lot of different technological solutions already available on the market and the others are in progress in the research laboratories. And given the new pattern of new advanced IT-tools often becoming affordable in just a few years time, I would claim that the suggested design improvements, or others along similar lines, probably will be viable in a not too distant future.
6.0 References


An example of a paper based scenario.
HÄLSOUNIVERSITETET
Sjuksköterskeutbildningen
Termin 3

Tema: Omvårdnad vid förändrade förutsättningar för aktivitet

David, 25 år, kommer in till akuten med svåra smärtor i vänster lårben, efter att ha fallit från en stege.
Blodtrycket vid ankomsten är 80/50 och pulsen 120. Röntgen visar att David har en femurdiafysfraktur.

Följande ordination ges:
Inj Ketogan 2,5 mg iv
Inf Ringer-acetat 1000ml
Inj. Fragmin 5000E x 1, s.c

Följande prover tas:
1) Blodgruppering, bastest, blodstatus, elstatus och PK-INR.
8.0 Appendix B

An example of an EDIT scenario - A long scenario
(Please visit http://huweb.hu.liu.se/edit/scenario/scenario1/index.html for further information about EDIT)
Part One. Background and a video clip

Jeanette Gustavsson 29 år, söker på p-p a smärta i nedre delen av ryggen med utsträning mot vänster klinka. Hon har haft värlk i länderbyn, nacka och axlar i flera år.

Under senaste månaden har dock smärtan i länderbyn ändrat karaktär och en utsträning mot vänster klinka har tillkommit. Smärtan har blivit allt mer oändlig och idag kan hon knappat gå. Jeanette beskriver dessutom myckhoppningar i vänster ben.

Tre-o-Comptabller (acetylsalicylsyra och kodein) som tidigare lindrat smärtan effektivt, hjälper inte längre lika bra trots att Jeanette tagit fleer tabletter än ordinarit.

Sambo, två barn. Röker 20 cigaretter per dag. Arbetar på silikonmonolage.

Sjukhistoria. Video

Status

Sjukteckning
Part one. Status and a drawing visualizing areas of pain

Status

- **Gott**: Smart påverkad.

Rörelseapparatur: Joanne Gustavsson går hållande på vänster ben. Lordosan i länderggen är minskad, ingen scolios noteras. Vid palpation av ryggmuskulaturen generellt spänd och uttalad paras vertebral ömhet föreligger i lumbosacrals områden.

Sidoböjningar och sidovridningar i länderggen sämst till vänster, huvud på vänsterben. Framåtbojning går bra upp till 30°, däruderväst småa i länderggen. Läs egens tecken positivt vid extension >30° vänster ben och >45° höger ben.

**Part two.** Patient status after 1,5 year and statistics on pain

Företagets hälsovården har kopplats in tidigare och man diskuterar möjligheten att ändra arbetsuppgifterna. Företaget har svårt att arbeta Jeanette arbetsuppgifter utan långvåga statska belastningsmoment. Vissa transportuppgifter skulle möjligen kunna bli aktuella.

Övriga tänkbara arbetsuppgifter kräver högre kompetens varför möjligheter till vidareutbildning med stöd från Försäkringskassan och eller Lansarbetarnamnden diskuteras.

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Tabell 1-3 antal värdelägen per 1000 invånare i Sverige 1995

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Part three. Concluding part

Jeanette Gustavsson lider av ett smärtsamt läge som orsakas av ett svalanget diskebråck på näven L5-V, som påverkar vanxor L5-rot. Detta förverkligar de vansterstidigare symptomen med utsträckande smarta motsvarande dormatornet L5 samt den nedgripa styrkan vid stortäckningen (M. extensor hallucis longus). Då täckningen behövs för hälsning är även denna funktion påverkad.


Psykosociala faktorer, såsom dålig arbetstillstånd och samband med belastning är mer sannolikt. Framförallt arbetemoment där en långvarig och monoton statisk belastning på nacke och axlar ingår medför denna typ av besvär. Även armarbete över horisontalplanet innebär en ökad risk.

Psykosociala faktorer, såsom dålig arbetstillstånd och samband med belastning och relationer till andra, kan också ha en föremögender betydelse. Det är således viktigt att närmare pennera den ergonomiska och psykosociala situationen både på arbetsplassen och i privatlivet och vid behov initiera åtgärder, t.ex. en arbetsplatsanpassning. Det är i Jeanettes fall svårt att bedöma om ländnngssproblematiken utgörs av en blandbild där också en belastningskomponent ingår.

Vid behandling av långvarig smärta skall medel som innehåller koden undvikas då risken för beroringsberoende är stor. NSAID-preparat och opioidbaserade medac med lägre beroringspotential (t.ex. tramadol) kan vara alternativ. Det är dock viktigt att i möjligaste mån utnyttja andra möjligheter att lindra smärtan, inte minst genom att identifiera och i möjligaste mån undvika moment som framkallar smynt.
9.0 Appendix C

Interview guide for students (translated from Swedish to English).

1) Please describe EDIT in your own words.
   - Point of view
   - Attitude

2) What function and affect has EDIT on your:
   - studies
   - education

3) What is EDIT’s role in the tutorial sessions?

4) What is required by the students to make the interaction between EDIT and its users to function well?

5) What would you like to change and develop about EDIT?

6) How would you describe the difference between working with Paper based scenarios and EDIT?

Interview guide for facilitators (translated from Swedish to English)

1) Please describe EDIT with your own words.

2) Describe your own role when working with EDIT.

3) What is required from the students and yourself respectively to make the interaction between EDIT and its users to function well?

What would you like to change and develop about EDIT?
# Interacting with EDIT.

## Abstract

This thesis aimed to study the interaction between an educational technology system and its users and give suggestions for design improvements. The technology system is called EDIT (Educational Development through Information Technology) and has been developed and applied at Linköping University’s Faculty of Health Science. EDIT supports Problem Based Learning and enables scenarios to be presented through the World Wide Web.

The study was divided into two parts. The first part consisted of a qualitative study with the objective to describe the interaction between the students and EDIT. Students from the faculty’s medical-, nursing- and social care programs were interviewed and observed using the system. The study showed that EDIT was not fully designed to support multiple user interaction. EDIT could only be operated by one user at a time which in turn resulted in an interaction reliant on the operators technical knowledge and ability to handle the system. The second part consisted of a redesign of EDIT. The design goal was to create a groupware that could be operated by multiple users. The design solutions were presented as lofi prototypes to three EDIT users. The users approved of the ideas but stressed the danger of using too advanced and unfamiliar technology.

## Nyckelord

human-machine interaction, educational technology, groupware, PBL