USING GROUPWARE TO LEARN SOFTWARE PROCESS IMPROVEMENT

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Abstract *¾ This paper describes the learning goals and organisation of a course in software process improvement given at the Norwegian University of Science and Technology, and what we see as the learning improvement after introducing a groupware tool for distributing course information and collecting hand-ins from the students. Software process improvement is a subfield of software engineering in Computer Science that aims to improve the quality of software products. This involves examining the way software is produced, the work process. A major challenge when giving a course in software process improvement is to learn students who are used to taking academic courses about problems that you normally find in an industrial setting. In order to encourage more discussion on the topics in the course, we started to use a groupware tool for handling exercises two years ago. This tool is accesses through the World Wide Web, and students have access to all course-related information. They are also told to publish their hand-ins here, where everyone has the possibility to see them. The comments given by teaching assistants is also shown here. During the last semester, we measured the usage of the groupware system, and find several interesting patterns: The most accessed documents are related to course organization and curriculum. Slides from class and exercises are downloaded a lot less. And it seems that the students read each other's exercises.*

Index Terms ¾ Groupware, Software Engineering Education, Software Process Improvement

INTRODUCTION

This paper describes the usage of a groupware tool in a course in Software Process Improvement at the Norwegian University of Science and Technology. Software Process Improvement is a subfield of software engineering, which is concerned with the process of developing software. The aims in this field is usually to get a better understanding of how software is developed, and try to make improvements so that the final software product either has

1) Higher quality, that is more satisfied users, better functionality, or fewer "bugs".
2) Lower development costs, which usually means reducing the number of hours spent on development.

In this field, many work with improving the way software is developed, the development *process*, which then is believed to create a better product. One example is to try to document what is done in a development project, so that it is easier to predict the time it will take to develop a new product. Other improvement initiatives can be to test some modules of a software system, or to inspect certain software modules. Inspection means to read through program code and discuss it to reveal errors.

This field differs quite a lot from other fields in computer science, in that is takes a very broad view of development, taking into consideration both organizational and technological factors. Many other courses are more concerned with algorithms or technical construction of say database systems. Also, most students who follow our courses have little experience with software development in real organisations, so it is challenging to teach this material, and give students a real understanding of what the problems in software development organisations are, and how such problems can be handled.

When teaching this type of material, it is often several approaches that can lead to good results, and there is no "single solution". It is therefore a subject that requires a lot more discussion than most other computer science courses which are more based on mathematics.

To increase the discussion in the class who followed the course last year, we started to use a groupware tool available on the World Wide Web. We will now discuss the usage of this tool, and what we think are the benefits. That is, we ask 1) How does the usage of a groupware tool influence the discussion on topics related to software process improvement? This will be the main topic in this paper, but we are also concerned with 2) How do the students participating in the software process improvement course use the groupware tool?

In order to answer these questions, we have analysed logs from usage of the groupware tool to see what usage patterns we find.

But first, let us introduce what we have thought in the course, and have a look at usage of groupware tools in other university courses. Then we will briefly discuss the research method applied here, before we analyse the usage of the tool in our course, and conclude with what we feel we have learned in applying this tool.

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FIGURE 1:
A SCREENSHOT OF THE BSCW SYSTEM, SHOWING FOLDERS, DOCUMENTS AND URL LINKS, AS WELL AS A SET OF COMMANDS FOR THE WORKSPACE (TOP) AND FOR THE DOCUMENTS AND LINKS IN THE FOLDER (UNDER "BSCW DEMO ENGLISH")

A COURSE IN SOFTWARE PROCESS IMPROVEMENT

Our course in "Software Quality and Process Improvement" (software process improvement for short) is given during one semester, usually with between 20 and 50 students, which are in their fourth university year. The learning goals of this course is to make the students:

1. Understand relations between process and product quality in software development.
2. Understand aspects of quality control in software development.

We believe that students learn through being active, so in addition to reading literature, we have exercises and organised discussions on curriculum topics.

The course consists of two main parts:

a) Theory, which used to be the book "Managing the Software Process" [1] which is a common book in software process improvement. But because this book mostly gives examples from an American context, we changed to a booklet written in a Norwegian Research Project instead [2]. This booklet gives examples from software process improvement programs in Norwegian companies, and relies on *Total Quality Management* [3] as an underlying philosophy.

b) Exercises, which are done in groups of six students. We have four large exercises:

1) Make a quality plan for a software development project that the students are doing in another course.
2) Participate in an experiment with different *inspection* techniques on a software program. Groups try out different techniques, and we analyse

how many defects (or "bugs") we find with each technique.

3) Make some quality goals for the same project as in exercise 1, and find some measurements in order to say if these goals are fulfilled or not. This also includes making a plan on how to find the measurements.
4) Analyse a set of data from a development project, and a model of the development process to find possible problem causes, and come up with suggestions on actions to improve the development.

We usually organise the exercises so that all groups produce a written report on each, but two groups also have the responsibility to present their results to the other students in class. The students then prepare some slides to make it easier for the others to follow. Another group responsible for asking questions. Thereby, we often have a lot of discussion on each exercise in class. A further description of this course can be found in [4].

GROUPWARE IN UNIVERSITY COURSES

Now, we will first discuss what a groupware system is, and then present articles found in the literature of usage of such systems in other related courses.

What is a Groupware System?

First, what do we mean by a groupware system? We can define it as a computer system which lets different people access information and communicate, where it usually is possible to see what other people has done with the common information, and which lets you set up meetings (for example over the Internet with NetMeeting), and communicate in discussion forums.

We have been using a simple tool, Basic Support for Cooperative Work (BSCW) which only needs a server and can then be used by people with normal web-browsers [5]. This system allows you to invite a set of people to share a "workspace" which can consist of a number of different files (like word-documents, excel-sheets, powerpoint slides), organised in "folders". When you log into the system, by looking up a www-page, and stating your username and password. You can see what changes has been done to the workspace since the last time you were in - that is, you can see what new files and folders that have been created, or read, and what "discussion" items that are new. You can also see if any files have been "updated" or deleted. As a user, you can "upload" you own files into the workspace.

The system was made available in 1995, and a royalty free licence can be received for educational purposes [6]. It has been in use at our university for some time, mostly in research projects, see [7]. Other similar systems include Hyperwave, LiveLink and Lotus Domino. For a further discussion of such systems, see [8]. A screen-shot from the system can be seen in Figure 1.

Groupware in University Courses

We find several other courses in software engineering who have introduced www-based help for organising the course. Also, we have found a paper about usage of the BSCW system in a course for social science students that we will describe.

At the National Technical University of Athens, an introductory course in software engineering has been supplemented by web-based "courseware", which includes:

- Online course notes
- A case study
- Course description, exam papers, solutions

Using the web, it is easier for the students to "progress at their own pace" [9], and makes the teacher more a facilitator than a traditional teacher.

At Helsinki Univeristy of Technology, another system has been introduced to administer student projects in a "Software Project" course. All material has been published on a course server, and "review meetings" with students and teachers are also scheduled using a home-made web-system. Comments from the review is also distributed in this way. The goals of this project was to reduce paper documentation, and improve the "control" of which documents that had been delivered during the project. "Deadlines are kept since there is no back door for late returns", and "there is much less uncertainty and simple questions to be answered, since students can find up-to-date information on the web", and the administrative work effort has been reduced [10].

The BSCW system has been used in a social science course at the University of Duisburg in Germany [11]. The goal was to support "collaborative learning" through making:

- all working material and results available.
- all participants actions transparent.
- it possible to communicate one-to-one, one-to-many or many-to-many.

In an evaluation of this trial, we find that the amount of interaction amongst students as well as students and teachers "increased heavily". From the students point of view "the availability of working materials and results as well as the immediacy to communication to others was considered as a great advantage and increased the level of motivation and effort". For the teacher, the "immediacy of communication and the options to overview the actions and results for each student was the most important effect".

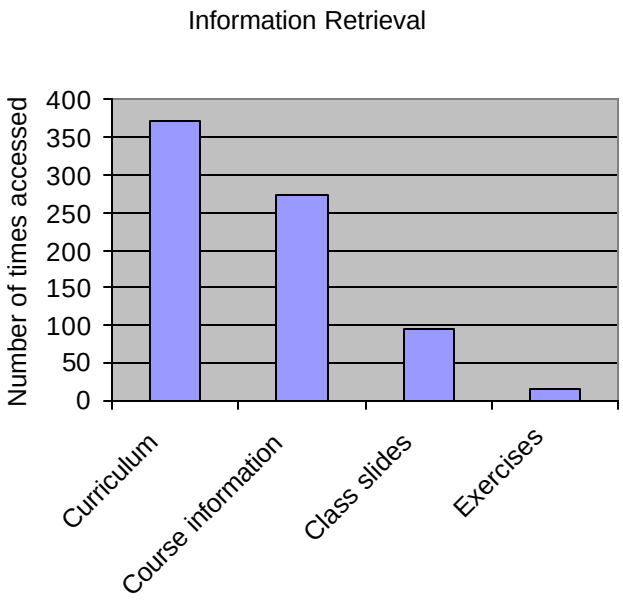

FIGURE 2:
CHART SHOWING HOW MANY TIMES INFORMATION OF DIFFERENT TYPES WAS ACCESSED DURING THE SEMESTER.

RESEARCH METHOD

Before proceeding, we would like to do a quick discussion of the research method used here. We have analysed some logs of the usage of the BSCW system for our course, but have not done any other form of data collection from students or other people involved. This work should be seen as an experience report from the people giving the course. The students participating might have different opinions on the effect of using the groupware system.

ANALYSIS OF GROUPWARE USAGE IN OUR SOFTWARE PROCESS IMPROVEMENT COURSE

For our course in software process improvement, we developed a workspace containing the following folders:

- Curriculum – the part of the curriculum that was available electronically.
- Slides – slides from all lectures in the course.
- Course information – information about the contents of the curriculum, lecture schedule, overview of student groups, and the schedule for presentation of exercises.
- Exercises – descriptions of the exercises as well as hand-ins and slide presentations from the groups. Here, they also find comments from the teaching assistant.

In addition to this, we also had a document in the "front" of the workspace with "news"; if delivery of an exercise was delayed, or the auditorium where a lecture was held had to change.

Four times during the semester, each group had to upload their exercise report. The groups responsible for presenting the exercise would also upload their presentation material. Some days later, the groups would find comments on the reports in the BSCW tool. This was all that the students would upload during the semester, except from comments and tips to improve the course.

The rest of the information in the workspace was provided by the course staff.

When we examine the log of what type of information that was accessed during the semester, we get the graph in Figure 2. We see that the information that was accessed the most, is the part of the curriculum which is available online. This was accessed in all 372 times, by around 25 students. Also, the course information was accessed a lot, 275 times, and then comes slides from lecture (95) and exercises (17). The number refer to the mean number of retrievals of the documents in this folder.

It was surprising that the online curriculum was accessed so much. 372 times divided by 25 students would mean that each student downloaded these files 15 times during the semester. So, it can seem that many students used the system actively as a "reader" and did not just print the documents found here.

It also looks like the students used the workspace as a place to look up information about the course, as course information also got a quite high retrieval rate. Lecture notes were usually provided as hand outs in the lectures, so this can explain why there were not so many downloads of this type of information. It was a bit surprising that it was not more than 17 downloads of the hand-in of exercises, which means that not all students downloaded these. It could be that students did not care to download their own exercise, and in that case, most of the others have read the other groups exercise almost once.

If we return to our questions in the introductory section:

How does the usage of a groupware tool influence the discussion on topics related to software process improvement? It seems that students take time to read other students material, and in that way participate in a kind of "discussion" – giving them more views on a topic than they would get by only reading a textbook. Although the exercise material could have been used more actively, it is at least a start. Students seem to use more "authorative" sources that are provided by the teaching staff much more, which leads us to our second question: *How do the students participating in the software process improvement course use the groupware tool?* In our course, it seems to have been used mostly as a "bulleting board" to find information related to the course, and not so much in supporting active learning processes. It might be that students would have another attitude to the self-produced material if they were encouraged to be more critical to the other sources that was used in the course.

FIGURE 3:
A SCREENSHOT FROM THE BSCW SYSTEM USED IN THE SOFTWARE PROCESS IMPROVEMENT COURSE, SHOWING HAND-IN'S OF EXERCISES.

CONCLUSION

So, can we say that the introduction of the groupware system lead to any improved learning situation for the students? This is of course a difficult question, and with the small amount of data that we have collected we cannot draw any firm conclusions. But it seems that the groupware system was actively used by the students during the semester. This might be because it was handy to have all material about the course available in one place, but it seems that they also used some time to engage in reading other peoples material, and engaging in a discussion of the material, which we think is an essential premise for learning in a course on software process improvement.

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