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ABSTRACT

The GMD (German National Research Center for Information Technology) has developed the BSCW (Basic Support for Cooperative Work) Shared Workspace system within the last four years with the goal of transforming the Web from a primarily passive information repository to an active cooperation medium. The BSCW system is a Web-based groupware tool for asynchronous and synchronous cooperation that extends the browsing and information download features of the Web with more sophisticated features for document upload, version management, member and group administration and more, to provide a set of features for more collaborative information sharing accessible with standard Web browsers. This paper describes the system and the experiences of using the system to establish a virtual learning environment for M.A. students of the Social Science Department of the Gerhard-Mercator University in Duisburg, Germany. The field study took place in summer 1998. It demonstrated the usefulness of the system for students and teachers as well as the need for further research and socio-technical redesign. (AEF)

Experiences with the BSCW Shared Workspace System as the Backbone of a Virtual Learning Environment for Students.

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Abstract: The BSCW system is a Web based groupware tool for asynchronous and synchronous cooperation. We describe the system and the experiences we made with it serving as the backbone of a virtual learning environment for students. The field study took place in summer 1998. It demonstrated the usefulness of the system for students and teachers as well as the need for further research and socio-technical redesign.

1. Introduction

The World Wide Web (WWW) is an addressing system, network protocol, document mark-up language and client-server architecture. In some sense it is also a collaboration technology, allowing people to share information in a manner which is not restricted to a particular system environment. The WWW has a number of advantages as the technological foundation for tools to support collaborative information sharing and teleteaching applications:

- WWW browsers are available for all important platforms and provide access to information in a platform independent manner;
- Browsers offer a simple and consistent user interface across different platforms;
- Browsers are already part of the computing environment of students.

GMD has developed the BSCW (Basic Support for Cooperative Work) Shared Workspace system within the last four years with the goal to transform the Web from a primarily passive information repository to an active cooperation medium. The BSCW system is an application which extends the browsing and information download features of the Web with more sophisticated features for document upload, version management, member and group administration and more, to provide a set of features for more collaborative information sharing accessible using standard Web browsers.

Since Web technology supports primarily asynchronous cooperation – people communicate and cooperate at different points in time – it can be used most rapidly for the construction of so-called *virtual workspaces*: information repositories for groups where they deposit any kind of information for their co-operation tasks and which they visit on a regular basis to retrieve the necessary information they need for fulfilling their tasks. In the meantime, the BSCW system has become quite popular particularly in the academic area and is used at a number of universities for a variety of applications.

We have used the system to establish a virtual learning environment [1; 2] for M.A. students of the Social Science Department of the Gerhard-Mercator University in Duisburg, Germany [3]. The system should technically assist the collaborative learning of the class and furthermore guarantee for all (students and teacher):

- The availability of all working materials and results;
- The transparency of the participants' actions to offer an orientation frame and social context;
- The awareness about the history of documents;
- The immediacy to communicate one-to-one, one-to-many, or many-to-many;
- The ubiquitous access independent from a prescribed place.

The students agreed to be part of the field trial and its evaluation. By this we wanted to gain knowledge about the collaborative learning of students via synchronous and asynchronous media (see chapter 3).

2. Functionality of the BSCW System

The BSCW Shared Workspace system is an extension of a standard Web server through the server CGI Application Programming Interface. A BSCW server (Web server with the BSCW extension) manages a number of shared workspaces, i.e. repositories for shared information, accessible to members of a group using a simple user name and password scheme. In general, a BSCW server will manage workspaces for different groups, and users may be members of several workspaces (e.g. one workspace corresponding to each project a user is involved with or, in the case of teleteaching, each course that a student has selected).

A shared workspace can contain different kinds of information such as documents, pictures, URL links to other Web pages, threaded discussions, member contact information and more. The contents of each workspace are represented as information objects arranged in a folder hierarchy.

In addition to the normal download of information from a Web site, users can also upload information from their local file system into a BSCW workspace. For example, a teacher may upload exercises into a workspace. Students download them onto their computers and later upload the "homework" they were expected to perform back into a workspace for review by the teacher. The following are the main features of the system (for more details see [4]):

- *Authentication*: People have to identify themselves by name and password before they have access to BSCW workspaces.
- *Version management*: Documents within a workspace can be put under version control which is particularly useful for joint document production.
- *Discussion forums*: Users may start a discussion on any topic they like and the system presents the threads in a user friendly manner.
- *Access rights*: The system contains a sophisticated access rights model which allows, for example, that some users may have complete control over an object in a workspace whereas others have only read access or no access at all.
- *Search facilities*: Users can specify queries to find objects within BSCW workspaces based on names, content or specific properties such as document author or document modification date. Furthermore, queries may be submitted to Web search engines and the result of the query can be imported into workspaces.
- *Document format conversion*: These facilities allow users to transform a document into their format of choice, e.g., a proprietary document format into HTML, before downloading it.
- *Interface to synchronous communication*: Through this interface users can specify synchronous sessions and launch respective tools, e.g., audio/video conferencing software or shared whiteboard applications.
- *Customization*: Through user preferences the users can modify the system interface to some extent, e.g., whether or not they want to use an Javascript or ActiveX enhanced interface.
- *Multi-language support*: The interface of the system can be tailored to a particular language by straight-forward extensions. Several languages (e.g., French, Spanish, Catalan) have been created by users of the system and are publicly available.

A cooperative system should provide awareness information to allow users to coordinate their work. The *event service* (activity reports) of the BSCW system is an attempt to provide users with information on the activities of other users, with respect to the objects within a shared workspace.

Events are triggered whenever a user performs an action in a workspace, such as uploading a new document, downloading ('reading') an existing document, renaming a document and so on. The system records the events, and presents the recent events to each user. 'Recent' in this context means events which have occurred for an object since the user last 'caught up' action, an operation by which users can tell the system they are aware of the events that have occurred so far and no longer wish to see them in the workspace. Events can be caught up at different levels, from individual objects to complete workspace folder hierarchies.

Each event entry describes what was done, when and by whom. Although this approach for providing group awareness is very simple, feedback from users of the BSCW system indicates that information such as 'A uploaded a new version of document X', or 'B has read document Y' is often very useful for group members in coordinating

their work and gaining an overview of what has happened since they last logged in.

Figure 1 is an example of the user interface of the BSCW system. It shows a listing of a folder containing three sub-folders ("bug reports", "proposals & remarks", "software"), a link object ("Public Server"), A MS Word document ("What's New"), an object containing the results of a WWW query at a search engine ("Altavista Search Results"), a meeting object ("final make (beta)") and a discussion object ("What do you think about ..."). The icon in front of each object's name indicates the type of the object. Behind each object is the name of the person who created the object and the date when it was created or most recently modified.

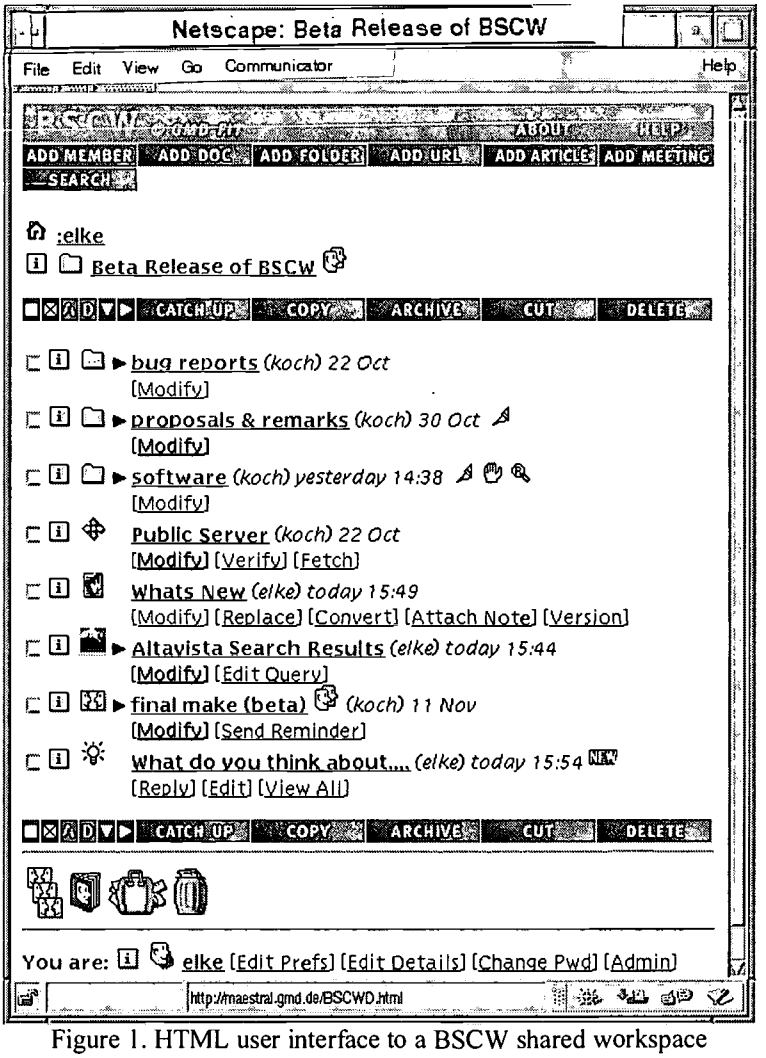

Figure 1. HTML user interface to a BSCW shared workspace

At the top of the screen there are buttons for triggering operations such as "Add Member" to provide access to this folder to other persons, or "Add Document", "Add Folder", "Add URL", etc., to create new objects within the folder. Other actions such as "Catch up", "Copy" or "Archive" can be applied to objects which have been marked through the tick boxes in front of each objects' name. Further action buttons appear in a line below each object (e.g., "Modify", "Replace", "Convert", "Edit Query", or "Reply") since they are only applicable to one particular object.

Behind three objects ("proposals & remarks", "software", "What do you think about ...") there are so-called event icons which indicate that an event occurred, e.g., the "What do you think about ..." discussion object is new since user "elke" visited this folder the last time and there have been modifications within the folders "proposals & remarks" and "software". Clicking on these event icons would give more details about the event, e.g., which user(s) triggered these events.

3. First empirical findings

During a three months period a class of 15 (5 female) students and their teacher (one of the authors) evaluated the usefulness of the system as an augmentation to the usual classroom teaching where interaction among students or students and teacher usually is limited to the face-to-face meetings and learning occurs usually as an individual cognitive task. It was our aim to add social aspects of interaction and collaboration to create a social collaborative learning environment to enhance the traditional approach. The data collection was done by the system (log files, screen shots, archiving of text chats etc.), the students themselves (amount of email, communication partners, personal impressions, self description of usage patterns), and by the teacher (use of the mailing list, the BSCW activity reports, activities on a CUSeeMe video server, interviews etc.). The study followed the principles of an ethnographic analysis [5] of cooperative work in practice under real life conditions [6]. The common goal of the course was to collaborately analyse and rate the web pages of the factions of the German Bundestag. The telecommunications expenses of the students were paid by the GMD.

Known teaching media like face-to-face lectures, papers, slides, and telephone were used. New was the BSCW system including a mailing list, email to persons or groups, and synchronous group meetings (virtual lectures) including video, audio chat, and text chat on a CUSeeMe video server situated in the GMD. These virtual synchronous group meetings lasted approximately two hours and were held instead of face-to-face meetings in the university. The students usually used their PCs at home to take part asynchronously as well as in the synchronous meetings. The students lived distributed in an area of 60 miles distance round the university. Few knew each other before.

As very often found in explorative studies, the amount of factors to monitor were so huge and even dynamically evolving, that it was hard to draw definite conclusions. That is why during Winter 1998 / 99 a second attempt is on its way to gain more and profound information . In this paper we name some interesting findings which could be condensed as first heuristic hypotheses.

Establishing social relations in a collaborative virtual learning environment is as important and even takes longer than establishing the technical prerequisites

To establish a social relationship among those who collaboratively learn is a process which takes time. It is an evolving process of mutual understanding, the development of conventions, and trust. It is an activity which has to be initialized and organized by the teacher. It is at least as important as teaching the use of the system. Although the students differed in hardware and software knowledge, the "technical" basis to interact could be established within one month of time.

Hardware and software has to be trained and cannot be left to self organization processes

Although the basic system functionalities are easy to learn a training concept is necessary to achieve equal options for all. Training included hours of practical homework for the students. To guarantee the success of the training it was followed by intensive coaching which lasted over the whole course. Leaving the responsibility of hardware and software training to the students (in the beginning of the field trial) created divergencies among them: power users evolved as well as reluctant users, which in few cases remained observers in the CUSeeMe sessions til the end of the course.

The role of video in synchronous virtual meetings is important but audio comes first, followed by text chat

In synchronous group meetings those who used actively video were active discussants and attracted more contributions than those who were lurkers. During this virtual conferences the main problems occurred with the audio chat. The problems were twofold: on the technical side the bandwith (modem with 33.6 Kbps or ISDN) was to narrow for a sufficient transmission over a longer period; on the social side the discussions had to be explicitely moderated by the teacher. Despite this it happened several times that we missed the leading thread and bypartisan discussions evolved instead of group discussions. As a conclusion we all judged unanymously, that CUSeeMe actually is not useful for teaching and group discussions but for the exchange of short infos, for the settlement of organizational questions, or for coordination and control.

Transparency and control is the Janus head of a virtual learning environment: both increased drastically

As shown in the previous chapters transparency, awareness, and immediacy of action were basic goals to achieve by applying a virtual learning environment. These are necessary requirements to add context to documents, actions, and individuals inhabiting the virtual environment. On the other hand it led to changes in behavior which reduced the positive effects. At the beginning students tended to present very cautiously working materials or results of their work. They were afraid of making mistakes or being compared and rated minor than their colleagues. Different styles evolved related to the gender. The female students tended to name their contributions e.g. as first, informal versions while most of their male colleagues presented themselves and their work more actively although there was no objective reason based in the contributions. This behavior equalized to the end of the course. In synchronous meetings some women behaved different than in the beginning. One could see them sitting at home drinking tea, smoking cigarettes and once the group was asked by a female student: "hi all, I am a bit late, did I miss something important?" This assumes that accomodation to the new situation is a relevant factor in virtual learning environments. To take the concerns about making "mistakes and bad exposures" serious a learning environment should offer protected areas or "play grounds" for those who first want to exercise.

The quantative and qualitative amount of interaction among students as well as students and teacher increased heavily

During the three months the "average" student sent app. 150 - 200 e-mails to his or her colleagues, 60 e-mails were distributed via the mailing list, the shared common folders of the group were used daily. We had 6 virtual group sessions on the reflector which lasted each time about two hours. Beside this the reflector was used for smaller group meetings or to directly address the teacher via video and audio. In the beginning most of the communication dealt with the use of technology (T) and organizational questions (O) later on unspecific (social) chat (C) and the discussion of the common task (I) dominated. The extensive use of the media did not lead to singularization or isolation of the students or the substitution of real life contacts. The contrary was the case: often once a week students invited the group for a physical meeting in a pub near the campus.

The new additional requirements like training, coaching, preparing and moderating electronically need much more time and work than the conventional teaching

The activities to initialize and vitalize the collaborative learning environment by the teacher and by the students themselves caused great efforts, at least threefold than usual. Everything - except the system - had to be established from the scratch. It was clearly shown, that a collaborative learning environment lives because of the communications and actions of the participants. The technical systems is an important but not sufficient basis. It can foster or hinder interaction. In our case the BSCW system was a great advantage for all.

New metaphors show the emergence of a new commonly shared virtual space for learning

Is the description 'virtual collaborative learning environment' pure rhetoric or reality? In the final interviews with the students at the end of the course we asked if the extensive exchange of information among the group led to the shared idea of a common virtual space. This was agreed by all. As approvements several arguments were given: the emergence of new roles (e.g. the supporter), the emergence of new behavior patterns (e.g. check mail in the morning and in the evening), the emergence of new socio-technical conventions (e.g. own video must have the same size as the others), the emergence of new metaphors understood by all especially during the video sessions (e.g. "Klaus is frozen" = only picture, no video; "let us meet on the daidalos" = name of the reflector etc.) and the fact, that although the course ended in July the shared workspaces of the BSCW and the mailing list is still in use (Oct. 98).

4. Conclusions

From the psychological point of view learning is an individual action. From the pedagogical point of view learning can be assisted by context and collaboration. Our field study showed that the BSCW system was a useful and promising tool to establish a network of communication and collaboration among students and teacher. The findings will be used to evolutionary redesign the system which thereby can be augmented by the perspectives and demands

of the users as participating actors of the design and use of virtual collaborative learning environments. From the students point of view the availability of working materials and results as well as the immediacy to communicate to others was considered as a great advantage and raised the level of motivation and effort. For the teacher the immediacy of communication and the options to overview the actions and results of each student was the most important effect.

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