Usability of Real-time Unconstrained WWW-Co-Browsing for Educational Settings

Maria Aneiros, Vladimir Estivill-Castro
School of Information and Communication Technology
Faculty of Engineering and Information Technology
Griffith University
{m.aneiros, v.estivill-castro}@griffith.edu.au

Abstract

The World Wide Web (WWW) and its associated browser-server technologies have become ubiquitous for the home, office and school environment. In the area of education, it has been argued that students can learn new ways of thinking and understanding by working in groups [6]. We have developed a tool that allows a group of users to conduct unconstrained collaborative browsing sessions in real-time over the WWW. We have conducted usability studies with volunteer students from South East Queenland, Australia. Our results show that students learnt to use the tool effectively and enjoyed using it.

1. Introduction

Today, the World Wide Web (WWW) and its associated browser-server technologies have become ubiquitous for the home and office computing environments. It is platform-independent and cross-organizational. It is a gateway to information, services and applications; whether a user is looking for work-related information, buying a product or finding friends, navigating the WWW has become part of one's everyday important activities.

Users navigating the WWW are often guided by the experience of other users. [24] have studied browsing in the context of searching library catalogues and found that it is a collaborative process; users often visit sites that have been recommended by friends or colleagues. These recommendations are usually word of mouth. Another method being used by e-commerce sites is ratings. Ratings are based on users voting on items they have purchased or on analysis of sales records, i.e. most popular items. Collaborative browsing sessions can help teams to find and retrieve information more effectively [24], as well as giving users another avenue to socially interact with colleagues, friends, and family.

One of the requirements of collaborative software is the need to provide awareness between participants. Collocated groups follow cues and information sources to keep track of the group's behaviour and progress; however, most of these disappear when users are no longer collocated [12]. What is needed is a tool that informs users about the activities of others. Additionally, in synchronous collaborative browsing users need to share ideas and opinions therefore communication is essential. A collaborative browsing environment must support a communication medium as well as showing cues to provide awareness.

Browser applications are individual applications and most users with access to the Internet know how to use one. Browsers could extend their functionality by becoming the interface for interaction with peers and friends as well as browsing the WWW. At present, some browsers offer collaborative or cooperative browsing (co-browsing), essentially through peer-to-peer guided navigation, i.e. one person is in control of the navigation (master) and another person (slave) sees the same thing [25] while at the same time interaction is facilitated through a chat/voice application. Of course, control can be passed to another in the team, and the old master becomes an observer, this model is analogous to watching television with one person in possession of the remote control. Recently, [1] proposed that the master/slave model is too restrictive and instead there is a case for unconstrained navigation during cooperative surfing sessions, that is, there is no master and every member has equal power and control.

People often help one another in the activity of knowledge construction both explicitly and implicitly; however, knowledge construction depends on information sharing. Sharing and disseminating information is the basis of any effective collaborative system and cooperative browsing gives users the opportunity to share information being collected over the WWW. Situations where this type of browsing will prove useful are in the areas of information re-

trieval, knowledge management, research, education and e-commerce.

In the area of education, [6] argue that students can learn new ways of thinking and understanding by working in groups. Additionally, educators have come to value the added benefit of the WWW for teaching. It provides an avenue that makes possible the creation of collaborative activities between participants not collocated near each other. Furthermore, co-browsing fits nicely into the theory of constructivism [2]. Given a task, students participating in co-browsing sessions build a history of their interaction and the WWW sites they deem important, thus, students can learn by exploring and sharing their own ideas and knowledge. Our system can be thought of as a cognitive tool that can help students to classify, share and show what they know.

2. Scenario

If you can imagine a group of students, enrolled in the same class but not collocated near each other, are given a research assignment: they must find information relating to a particular topic. They are allowed to work on it together; however, they may have to produce individual reports. They agree to do it together and arrange to meet on the Internet at a particular time. They log-on and start researching using search engines and the like. They use a Chat tool to talk to one another, and they use a History tool to share the information found that is deemed worth while. At the end of the session they all end with a list of references that not only contains the URL and title but also annotations and ratings to judge each link's usefulness. In addition, other information can be kept for future needs; for example, the date and time the page was accessed may be used for referencing later.

The key improvement of this system is that the student can see immediately the identity of other students, as well as the annotations and ratings left by other students on a web page. In addition, they can keep a conversation going regarding the information being accessed. Similarly the student can add his/her own annotations and recommendations for the other members to see on real-time.

This scenario suggests how a real-time environment can be used to help groups of students find information faster and to help one another in developing researching skills to accomplish their tasks. Alternatively, a teacher could use the list of resources found by the students to show them how to research on the web and how to judge and reference information properly. Our Group Unified History, GUH, is designed to support this scenario by implementing WWW page annotations, ratings and the use of a Chat tool on real-time.

Research in the field of computer supported collaborative learning suggests that computers must assist and en-courage learning, however, students must work out the answers to the problems. This setting encourages students to collaborate and help each other learn. Our main aim is to provide an atmosphere where people can carry out unconstrained real-time collaborative browsing and we have put this to test within an educational environment. An educational environment provides a perfect domain for this type of system.

3. Description of System

The Group Unified History tool was developed for the requirements mentioned in the previous sections. It shows a view of all members that are connected at the same time, as well as a History tool that shows the individual as well as the group's history, this provides awareness. Additionally, it allows members of the group to chat by a Chat window, to provide communication. The following sections give a brief overview of our GUH, its infrastructure and the user interface.

3.1. System Overview

The GUH prototype system is designed to support communication between clients by a Chat server and access to the WWW by a Proxy server. When a user logs-on to the system, it starts the Chat and loads the GUH. Every time a user sends a HTTP request from his/her browser, it goes by the Proxy server. The Proxy server connects to the requested sites and passes this information to the GUH server. The GUH server shows the updated history information to the client. A client can annotate or rate a web site by communicating directly with the Ratings/annotations server; this server then passes this information to the GUH server so updates can occur for all clients. All history information, annotations and ratings are stored external to the content of a web page, as users do not have write access to web pages. The GUH server provides all this information to the client as part of the updated history, this in turn, allows users to visit sites that others have judged or commented positively as well as make future judgments themselves. Figure 1 shows a system overview.

3.2. User Interface

The user interface has been kept as simple as possible, a HTML page within a browser window allows users to get acquainted with the functions very quickly as very little instructions are required. Figure 2 shows an example of a screen. On the GUH page, different symbols have been used to represent the annotations and ratings capabilities of the system, as well as the identity of the users logged onto the system. This results in the creation of an environment
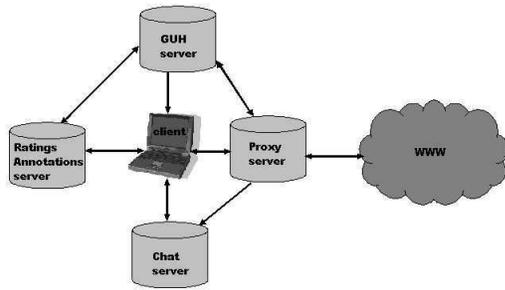
Figure 1. System overview.

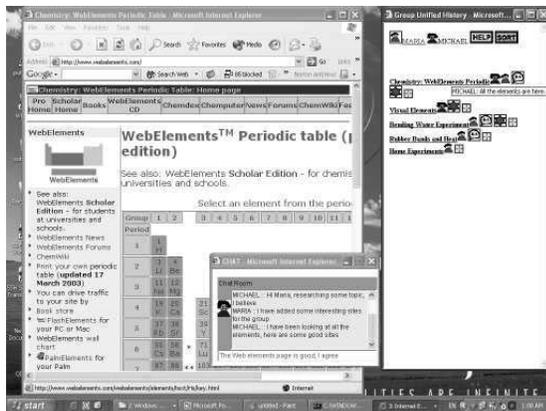where users are aware of the other members of the group and their contribution to the group's task.

Figure 2. GUH interface example.

3.3. Awareness Functions

Once a user has logged-on, an image icon is associated to the identity of that user. Users are allowed to see their own history items, as well as the history items added to the GUH. A user can add a web page to the group by clicking on the last icon and following instructions. The instructions let users know that they can rate or annotate the web page as well. The order of the users' icons next to a URL's title is the order in which the page was viewed by those members

3.4. Annotations and Ratings

To annotate a page a user fills in a text box, provided by the system upon adding a web page, this in turn shows a new symbol to all users indicating that the web page is annotated. For example, by placing the mouse over the annotated symbol any member of the group can read the annota-

tion, see Figure 3. Similarly, if a user rates a web page, a colored star symbol is added, every other member of the group will see the average rating by placing their mouse over the colored star. The color is also an indication of the value of the rating, with red being the highest and yellow the lowest. In the example above there are red and orange colored stars.

3.5. Communication

Real-time communication takes place by the Chat window as can be seen in Figure 2. This window contains an applet that makes possible the interaction between the members of the group. Any message posted in this window will be seen by all members of the group. Similarly to the GUH, the identity of the user is associated with an icon (the same image that is shown on the GUH).

3.6. History Interaction

History interaction can be passive or active. By passive we refer to users who simply watch the GUH window and read the rating and comments of others by placing their mouse over the symbols. By active we refer to users who click on the symbols to allow them a better view of the information, for example by clicking on the speech bubble icon of any web site a new browser window will open up, it will show all the information that has been added, that is, annotations and ratings, and by whom, as well as allow the user to add their own annotations and ratings for others. The GUH provides awareness, that is, users can see the contribution of each member of the group to the GUH. Passive or active interactions allow for different social protocols to be applied.
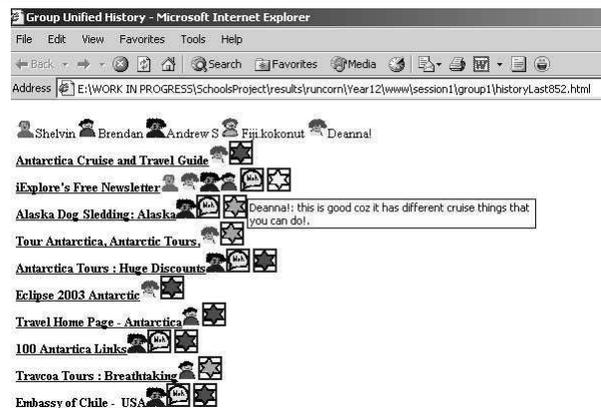

Figure 3. View of a group's GUH.

4. Experiment

One of the largest problems faced by developers of collaborative software is the difficulty in modeling real-world environments for testing. Since this is almost impossible to achieve, we decided to take the system to the real world and let the users test it. We corrected problems between tests, thus we have been (and still are) using an iterative development model. Taking the GUH to different networks under different administrators has shown us how heterogeneous environments are, and also the flexibility of the tool to fit into any of them. Nevertheless, each new environment is introducing us to problems that we have not encountered before and would have not been able to identify in our own more homogeneous environment.

4.1. Participants

We approached secondary schools in South East Queensland, Australia. Teachers were asked to volunteer classes that were involved in researching over the Internet. Students within those classes then volunteered to take part in the testing. Groups were made up of three to five students and as many groups as possible. To date, we have tested the system with three classes in three different schools. We have tested as many as five groups at once (a whole class) and a total of approximately fifty children have taken part in the testing. We are currently in iteration number four. Figure 4 shows a class testing the GUH.

Figure 4. Students testing GUH.

4.2. Method

Most student volunteers belonged to the same class and had access to computing laboratories where all computers were situated in one room. We imitated the "not collocated near each other" part by assigning them to computers that

were not next to one another, for example if we had four groups, we allocated the first computer in a row to group A, the second computer in the same row to group B, etc. This guaranteed that students were far enough away from other members of the same group and since each group was given a different topic to research they would not be interacting with the other students sitting next to them. The testing took approximately two hours. Volunteer students were assigned randomly to groups.

During the first test students were given written instructions for the usage of the GUH, this hampered the testing process as most participants skipped reading the material and starting interacting with the system without any knowledge of its usage. This was changed to giving students a ten minutes presentation on the functions and usage of the GUH before they started any interaction with it. They were allowed to logon with any name of pseudonym they liked. Students within the same group were given the same task by their teacher, that is, the same research topic. They were given thirty minutes to research that topic using the GUH and then they were given a ten to fifteen minutes break. Next, students were given a second research topic by their teacher and given another thirty minutes to do the research. In all, students participated in two separate sessions, and in each session a different version of the GUH was used, for example some groups only had the chat functionality and not the history functionality for one session, while in the next session they were given a version of the GUH with both the history and the chat functionality. Finally, students were allocated ten minutes to complete a questionnaire and among other questions were asked to judge which of the two versions they found more useful. The following section explains the results from this questionnaire.

4.3. Preliminary Results

Questionnaires contained three styles of questions. The first style were mostly on a scale from 1 to 5, with 1 being the most negative answer while 5 being the most positive one. Questions on this part dealt mostly with usability issues, for example, "*how difficult was it to interpret the user identity symbols used in the tool?*" or "*did you visit any web sites found by your team/peers using the group history?*". The second style of questions had multiple-choice answers with more than one answer being possible. Questions on this part dealt with errors or problems encountered and what each user liked and disliked about the tool. The third style of questions were open and they are discussed in detail in the following sections.

One of the first things to notice was the need for students to become familiar with the tool and its usage. We encode the first school as IGS, the second as CAB and the third as RUN. A set of instructions was developed and given

to the first group of students that tested the system (IGS) in printed form. However, the students did not read the instructions and instead trusted their own intuition and knowledge of browser usage. This resulted in a lot of wasted time as the researchers had to show students individually how to use the tool. For the second and third group of students that used the tool (CAB and RUN) we developed an interactive presentation before the experiment, students in these two groups show a much higher understanding of the tool usage. Similarly, students were asked to judge their difficulty in interpreting the symbols shown and their use. The responses illustrate a similar trend to the first question, where the third group, RUN, show a much higher understanding of the tool's usage. Overall, the results show that most answers were above 3, that is, they did not find the experiment difficult. The lowest answers were from IGS highlighting the problems faced with the original delivery of instructions.

Students were queried on the numbers of errors they found and if they liked or disliked parts of the tool. Overall, 50% of students answered there were errors with the history tool and 30% answered there were errors with the chat program, while these numbers seem high there were a number of contributing factors that were beyond our control, for example, one student kept getting every line of the chat program shown twice, upon investigation it was discovered that there was a problem with her monitor and not our system. Most students liked the ability to chat with others in their group while browsing the web, while over 55% of users voted that they disliked none of the features in the GUH.

Similarly, more than 60% of students said they had visited sites found by other members of their team using the GUH. Additionally, 30% said they had used the rating and annotation tool to recommend sites to others, refer to Figure 5. This indicates that the students were able to use the tool effectively.

The experiment took part over two sessions, on each session students were given a different version of the system, for example on the first session they were able to use history and chat, while on the second session they were only able to use chat as their only means of collaboration. Results from the questionnaires show that if a student was given a tool with less functionality to use in the first session, then he/she preferred session 1 as the more enjoyable and productive for the team. Similarly, if a student was given an easier tool to use in the second session then he/she preferred the second session. Students that could not remember which tool was easier are equally divided across sessions.

4.4. General Feedback

At the end of each questionnaire students were asked a set of open questions, the following is an overview of their
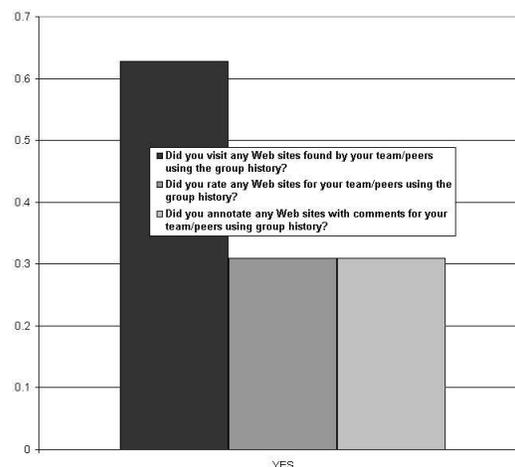

Figure 5. Usage of GUH.

responses to each one:

- *How did you make sure your team noticed the information you found?* Most of the answers to this question showed students' grasp of the tool, with a typical reply being "I told them I had found a good site, in chat, then added it to the history".

- *How did you come to accept that the information from others in your team was useful for the task?* The responses to this question show that some students were using the tool very effectively with one reply being "by reading their information I found out things about the research topic that I did not know before" or "I found a very useful site using the history so it was good".

- *In your opinion what is easy about collecting information as a group?* The answers to this question fall under three categories. The first one was students thought it was a faster way to collect information, a typical answer was "you can get more information collected quicker". The second category shows clearly the so-called "free rider effect", students liked it because, quoting a typical answer, "other people do it" or "you don't have to do it all your self". The third type of response falls under the category of collecting a wider range of information, with some typical comments being "if you collect information as a group, you can gather a wider range of information and learn more. It also gives you the ability to learn how to communicate with others well" or "allowing for other ideas to come through that you might not have necessarily thought of". The comments show how students perceived the tool would help them with their own learning.

- *In your opinion what is hard about collecting information as a group?* A typical answer for this question

was "it is easy to double up" or "some people may not be working as hard and you don't know whether you are all looking at the same sites and therefore wasting time". Time wastage and staying on track seem to be the main concerns identified by these groups, with a large proportion of students admitting that being able to chat made it easy to stray from the given task.

- *Any other comments you would like to make?* The answers to this question were all positive, students either made minor comments like "this was great" or "it was a fun way to research" or gave some comment about features that could be improved, for example "I think some of the history tools are unnecessary. The speech bubble and url bit was useful".

Overall the results have shown us that students liked the idea of finding information from the WWW as a group, however, the ability to socialize (chat) during the experiment was at times distracting them from their task. In general, they have given us very positive feedback and the experiment is continuing.

5. Related Work

Many researchers have worked in the field of collaborative browsing; however, most of the applications studied belong to the master-slave model [8, 5, 10, 11]. While this model is useful in some situations, our model of collaborative browsing belongs to the unconstrained variety where all users are in control of each session, that is, there is no imposed protocol on the usage of the system [1]. The users themselves will develop their protocol depending on their social model of interaction; the system only provides the environment.

It has long been established that students working alone under perform with respect to students who help one another and learn as groups [13, 14]. Teachers have used cooperative learning to improve their students' academic achievement, motivation, attitudes and so on [9, 22]. Grouping pupils is not by itself a factor to guarantee successful cooperative learning [16, 19]. Successful cooperative learning depends on teacher's selection of suitable group structure (group composition, group size, incentives) and resources [20], special care is required with computer supported collaborative learning environments [17, 18]. Another important aspect for success is the form of student interaction (facilities and modes for communication and mutual assistance), specially with computer technology [26, 3, 15]. While very sophisticated and elaborated systems have been developed for computer supported collaborative learning over the WWW [4, 7, 23], there is very little in terms of more flexible, simple and generic collaborative browsing that would enable

collaborative learning from information gathering exercises as a group. Research assignments for teams, where a collective history of the groups exploration for information is managed, could parallel the collective induction of schemas as proposed by schema construction theory. We provide a tool for the administration of an annotated collective history of the team's research effort that allows the users to sort out useful information for the group and relevant information related to the research task over irrelevant information. We believe that our tool allows rapid familiarization with it and the team development of research resources from the WWW via collaborative browsing.

Furthermore, [6] argue that individuals working in groups learn new ways to solve problems and they learn cooperative skills such as how to be open minded to others' opinions, ideas and insights. Education itself is shifting from teaching individualized work skills to collaborative learning, where students have to interact with one or more students in order to solve given problems. The challenge is how to design computer supported collaborative learning tools that support this trend. Additionally, [21] argue that computers must be a tool to encourage and assist students to make the most of their skills, intelligence and knowledge; however, it should be the students and not the computer that work out the problems. Our system allows students to collect and share information, to communicate and be aware of members' contributions to the group.

In designing collaborative software we have to be aware of the processes taking place when people want to perform a collaborative task, according to the "usability first" (www.usabilityfirst.com) web site on Groupware: Design Issues one way to achieve this is to conduct user studies on system prototypes. We have followed this approach to try and understand the real-world requirements of such a complex domain such as Education.

6. Conclusions and Future Work

The World Wide Web (WWW) and its associated browser-server technologies provide a perfect environment to deploy computer supported collaborative tools. We have developed and tested a collaborative browsing tool, GUH, using volunteer students from three schools in South East Queensland, Australia. Our results show that students learnt to use the tool effectively. They were aware of other students' contributions and over 60% reported to having visited sites recommended by their peers. Additionally, over 30% used the annotations and rating functionality to recommend sites to others. Furthermore, a vast majority expressed they enjoyed the experiment and some suggested they would like

to do it again. The feature they reported to like best was the Chat tool, 80-90%, even though they admitted to being distracted at times and stray from the given task. Problems were experienced, during the testing, due to the heterogeneous types of environments where the GUH was used, however, this has given us an understanding of the requirements for setting up the tool that we could not have known otherwise.

One of the many areas that we did not explore is the assessment of the students' collections, that is, not just the tool usage but also the quality of the material collected by the students. Teachers' specific requirements are other areas that need further exploration. Nevertheless, the results and enthusiasm from the students have been encouraging and the experiment is continuing, we hope to report more results from these areas in the future.

References

[1] M. Aneiros and V. Estivill-Castro. Foundations of unconstrained collaborative web browsing with awareness. In *In IEEE/WIC International Conference on Web Intelligence (WI'03)October 13 - 17, 2003*, pages 18–25, Halifax, Canada, 2003.

[2] J. Bruner. Constructivist theory. explorations in learning and instruction: The theory into practice. *(TIP) Database. [viewed 18 Nov 2004]*, 1990.

[3] E. Cohen. Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research*, 64:1–35, 1994.

[4] P. Dillon. Teaching and learning with telematics: an overview of the literature. *Journal of Information Technology for Teacher Education*, 7(1), 1998.

[5] A. W. Esenther. Instant co-browsing: Lightweight real-time collaborative Web browsing. In *In Proc. of the 11th Int. WWW Conference, May*, pages 107–114, Honolulu, Hawaii, 2002.

[6] P. Feltovich, R. Spiro, R. Coulson, and J. Feltovich. Collaboration within and among minds: Mastering complexity, individually and in groups. *CSCL: Theory and Practice of an Emerging Paradigm*, pages 25–44, 1996.

[7] H. Fulks, M. Gerosa, and J. P. de Lucena. Groupware technology for cooperative learning via the internet. In *In 35th Annual Hawaii International Conference on System Sciences (HICSS-02)*, volume 1, page 4, 2002.

[8] G.Cabri, L. Leonardi, and F. Zamborelli. Supporting cooperative WWW browsing: a proxy-based approach. In *In Proc. of the 7th Euromicro Workshop on Parallel and Distributed Processing*, Madeira, 1999. IEEE CS Press.

[9] T. Good, C. Mulryan, and M. McCaslin. Grouping for instruction in mathematics: A call for programmatic research on small-group process. *Handbook of research on mathematics teaching and learning*, pages 165–196.

[10] T. Graham. Groupscape: Integrating synchronous groupware and the world wide web. In *INTERACT'97*, Sydney Australia, 1997. Chapman and Hall.

[11] S. Greenberg and M. Roseman. Groupweb: A WWW browser as real time groupware. In *In Human Factors in Computing Systems, CHI Companion Proc*, pages 271–272. ACM Press, 1996.

[12] C. Gutwin and S. Greenberg. Design for individuals, design for groups: tradeoffs between power and workspace awareness. In ACM Conf. Computer Supported Cooperative Work (CSCW'98), pages 207–216, March 1998.

[13] D. Johnson and R. Johnson. Instructional goal structure: Cooperative competitive, or individualistic. *Review of Educational Research*, 44:213–240, 1974.

[14] D. Johnson and R. Johnson. *Learning together and alone: Cooperative composite and individualistic learning*. Allyn and Bacon, 4th edition, 1994.

[15] A. R. Kaye. Learning together apart in collaborative learning through computer conferencing. *The Najaden Papers*, 1991.

[16] P. Laughlin, S. VanderStoep, and A. Hollingshead. Collective versus individual induction: Recognition of truth, rejection of error and collective information processing. *Journal of Personality and Social Psychology*, 61:50–67, 1991.

[17] D. McConnell. Tutoring and learning in cscl and face-to-face environments. *Implementing Computer Supported Cooperative Learning*, 1994.

[18] D. McConnell. What is cooperative learning? *Implementing Computer Supported Cooperative Learning*, 1994.

[19] F. Newman and J. Thompson. *Effects of cooperative learning on achievement in secondary schools: A summary of research*. University of Wisconsin, National Center of Effective Secondary Schools, Madison, 1987.

[20] T. O'Sullivan, J. Rice, S. Rogerson, and C. Saunders. How do groups work. *Successful Group Work*, pages 55–78, 1996.

[21] M. Scaradamalia, R. Bereiter, M.J.Swallow, and Woodruff. Computer-supported intentional environment. *Journal of Education Computing Research*, 5:51–68, 1989.

[22] R. Slavin. *Cooperative learning: Theory, research and practice*. Allyn and Bacon, Boston, 2nd edition, 1995.

[23] K. Tourchin. Using the internet- using the internet for collaborative learning (k-8):what has research revealed? *Ontario Institute for Studies in Education*, 1996.

[24] M. B. Twidale, D. M. Nichols, and C. D.Paice. Browsing is a collaborative process. *Information Processing and Management*, 33(6):761–783, 1997.

[25] H. Wagner. Tracking the navigation behavior of Web communities. Master's thesis, Department of Computer Science, U. of Munich, Germany, 2002.

[26] N. Webb and A. Palincsar. Constructive activity and learning in collaborative small groups. *Journal of Educational Psychology*, 87:406–423, 1996.

IEEE
COMPUTER
SOCIETY