Developing Collaborative Tools to Promote Communication and Active Learning in Academia

Scott Frees[1], G. Drew Kessler[2]

Abstract - **Groupware applications such as AOL's Instant Messenger and Microsoft's NetMeeting have been growing in popularity in the general public for many years, starting with students on college campuses and more recently gaining acceptance in the business world as effective tools to aid in communication and productivity. Although many of these technologies were first popularized on college campuses, their use has yet to be integrated into the student/instructor teaching relationship, remaining more widely used between students for social purposes. In this paper we present the Cimel Collaborative Tools, a set of integrated groupware applications designed to improve communication between students and instructors and promote an active learning environment for students. In addition to the standard contact list and text messaging functionality, the Cimel Collaborative Tools provide a desktop sharing tool and a course-specific frequently asked questions (FAQ) database.**

Index Terms - application sharing, collaborative tools, instant messaging, groupware

INTRODUCTION

Groupware applications such as AOL's Instant Messenger and Microsoft's NetMeeting have been becoming commonplace in the workplace and are widely viewed as effective tools in aiding communication and productivity. Although many of these applications were first popularized by students on college campuses, their use has yet to be integrated into the student/professor teaching relationship. The scenario below is used to better explain the current inefficiencies in the student/professor relationship and where the use of groupware applications such as the Cimel Collaborative Tools works to solve the problem.

Alex and Jane are currently both taking a User Interface Design at a local university. Professor Roberts has assigned a project which requires them to build a user interface using Microsoft's Visual Studio. While working on his project, Alex is unable to configure a Picture Control to display bitmaps and emails Professor Roberts to set up a meeting in order to get help. A meeting is scheduled for the next day and

Professor Roberts shows Alex how to solve the problem. Another day goes by and Jane is having trouble with the same issue, however she is unable to reach Professor Roberts before the project is due and is unable to complete the project in time.

This is a specific example of some of the difficulties that arise where students have problems getting their questions answered. Since the problem Alex was having would have been difficult to explain via email, Alex had to wait until Professor Roberts' next available office hours, even though the solution to his problem was relatively easy to show. Furthermore, Jane would have been able to complete her project if Professor Roberts had been available or if she had known to ask Alex for help. Unfortunately Professor Roberts was at a conference and as is often the case where classes are large, these two students did not know each other.

The remainder of this paper describes the Cimel Collaborative Tools, a set of integrated groupware applications which provide solutions to the type of problems described in the scenario above. The Cimel Collaborative Tools consist of a set of screen sharing applications (collectively called ShowMe) along with a contact list which provides a text messaging service and a starting point for ShowMe sessions.

RELATED WORK

The Cimel Collaborative tools is part of a broader research project, "Constructive, Inquiry-Based, Multimedia Learning in Computer Science Education", (entitled CIMEL), which centers on the investigation and implementation of an integrated, multi-track model of constructive, inquiry based learning [1, 9]. Our work differs from most groupware research in that we are developing an integrated set of teaching aids focused on helping students learn in a self-contained academic environment.

Instant Messaging (IM) has been popularized in the form of America Online's Instant Messenger[10], and Microsoft's Messenger[12]. These services all provide their users with client software which logs them into proprietary networks and provides them with an interface to write text messages to other users. Users identify themselves by a nickname and can add

October 20 – 23, 2004, Savannah, GA

other people's nicknames to their "buddy list". Users can add friends and co-workers to their buddy list by obtaining their nicknames through personal contact. Our software includes a ContactList which resembles the buddy lists contained in most common IM clients and allows users to text message their fellow students and instructors. The fact that our system is self contained provides many privacy and security benefits, such as the absence of the emerging problem of SPIM (spam for instant messaging clients). Our software also automatically organizes and presents the buddy list according to the courses students are registered for, eliminating the need obtain nicknames of other students. Studies [4] have shown the use of IM by teenagers has grown at an astounding pace over the past few years. The fact that IM has become such a substantial part of the culture in this age group is a strong indication that IM use in an academic setting could be a good way to improve communication between students and instructors, a sentiment reflected in our survey results which will be discussed later on in this paper. Studies of IM in the workplace also points towards IM's ability to improve productivity [6, 7, 8].

Our ShowMe applications promote a "Learn by Doing" approach that enables an instructor to view a student's desktop and use annotations and text messages to guide students towards solutions. This is similar, but different than application sharing programs, where instructors can actually take control of the student's computer and solve the problem for them. We are not aware of any existing applications that enforce the type of active learning that ShowMe sessions accomplish. The most well known application sharing program is Microsoft's NetMeeting[13]. NetMeeting supports online conferences by providing video conferencing, text messaging, and application sharing. NetMeeting's application sharing feature allows users to view and/or control programs running on another user's desktop. When sharing an application in NetMeeting, users must agree on who has control over an application at any given time, no two people in the conference can control the shared application simultaneously. Our screen sharing application (ShowMe) does not allow remote program control, however it does allow each user involved to control their own individual cursor and to draw annotations on the shared desktop simultaneously. ShowMe also differs from other presentation oriented shared whiteboard applications such as Centra[11] in that annotations are created on top of subject content, not apart from it.

Other research has investigated how application sharing applications are used in the workplace. One study [3] looked at software engineers at a telecommunications company and focused on the adoption of the technology within the group. Their findings suggest that although employees generally gave positive feedback, adoption was very sensitive to the amount of effort required to start up conferences and that users who were not "pushed" by a team leaders rarely used it at all. In case studies conducted with our ShowMe software we have run into similar adoption problems despite positive feedback from students.

SOFTWARE DESCRIPTION

The goal of the Cimel Collaborative Tools is to provide students and instructors with an integrated platform in which they can collaborate with each other in real time without having to schedule office hours or wait for email responses, along with a way for instructors to post previously answered questions allowing students to get solutions to their problems when the instructor is unavailable. The system consists of three integrated applications which address each of these goals in various ways.

- Contact List/ChatClient - provides users with the ability to text message any student or instructor in his or her course.
- ShowMe - a peer to peer screen sharing tool which allows users to share parts of their desktop with others. The ShowMe application consists of a few parts, the ShowMeLive application shares a user's desktop, while the TeachLive application displays the peer's desktop on the "instructor's" computer. Within these applications, both users have the ability to draw annotations and text boxes on the shared desktop in order to convey information and assistance. In addition to these applications which support live ShowMe sessions, the DemoPlayer allows for playback of previously recorded ShowMe sessions.
- Multimedia FAQ (mFAQ) - a searchable database which stores previous text conversation and ShowMe demonstration videos for others to view later.

Contact List

The Contact List application is the hub of the Cimel Collaborative Tools. When a user logs in he or she is presented with the familiar instant messaging contact list interface. This contact list (shown in Figure 1) differs from publicly available instant messengers in that it automatically organizes users into the classes they are in and according to the roles they play in each class (i.e. instructor, student, etc.). From this list the user can get each user's full name, email address, and also find out what other classes they are taking. This information can be useful in building inter-student communication, but would not be plausible in a publicly available instant messenger because of the obvious privacy concerns.

By clicking on another user in the contact list, the user can send an instant message and converse in a similar manner as in virtually all of the other popular instant messaging applications. The contact list also holds a list of relevant discussion boards or conference rooms – again, organized according to class. The user is only presented with conference rooms which pertain to the courses they are currently enrolled in. Students can use this feature to collaborate with multiple students (they have the ability to create private and public conference rooms) or post unanswered questions. Instructors can also use this feature to hold online office hours with groups of students.
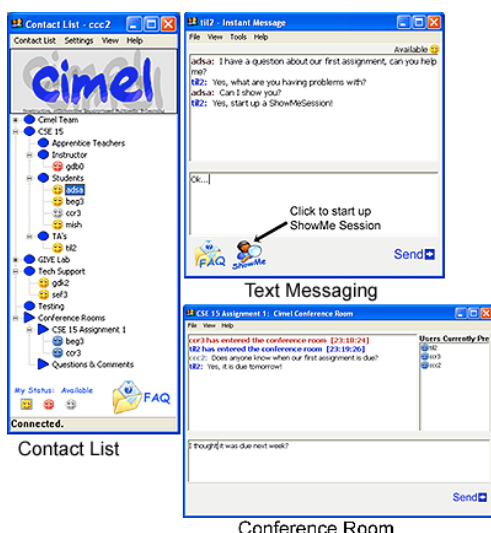
FIGURE 1
CONTACT LIST/CHAT CLIENT

ShowMe Applications

The ShowMe applications have been designed to allow students to "show" an instructor the problem or questions they have by sharing their desktop. To do this, the student and instructor must first agree to participate, which is negotiated through the Contact List by clicking on the "ShowMe" button on their text messaging interface as seen in figure 1. The ShowMeLive application is then launched on the student's computer and connects to the TeachLive application which is started on the instructor's computer. Once the applications establish a connection, ShowMeLive immediately begins to stream the student's desktop in full resolution and color depth to the TeachLive application, which displays the images in a display window in real time.

The ShowMeLive application displays a thin blue outline around the area of the student's screen that is currently being shared called the "Sharing Window". This rectangle can be moved and resized to give the student complete control over which parts of the screen he or she wants to share. Both the ShowMeLive and TeachLive applications capture the local user's mouse cursor position and stream them to the peer, so each user can see where the other user is pointing; for ShowMeLive, the instructors cursor is drawn directly onto the desktop, while with TeachLive the students cursor is draw in the display window. Both applications allow each user to draw annotations on the shared desktop, including rectangles, lines, arrows, and text boxes. Integrated into these applications is a text messaging interface which has been streamlined in order to fit nicely inside the ShowMeLive and TeachLive application windows. The instructor using the TeachLive application cannot gain control over the student's computer or application, however he or she can draw annotations on top of the students screen (and send text messages). We believe that this method is actually the method of choice for our intended audience since it encourages active learning on the student's part. The ShowMe applications force the student to perform the appropriate actions in order to

solve his or her problem, while allowing the instructor to oversee what is going on and make suggestions and/or guide the student to the solution. During ShowMe sessions the TeachLive application saves the incoming screen images along with both user's cursor positions and drawn annotations. Once the session is ended, the instructor has the option to save the file locally in a playable format. The provided DemoPlayer can then play locally saved ShowMe demonstrations or connect to a central database (via the mFAQ) and play stored demonstrations which are streamed over the network.
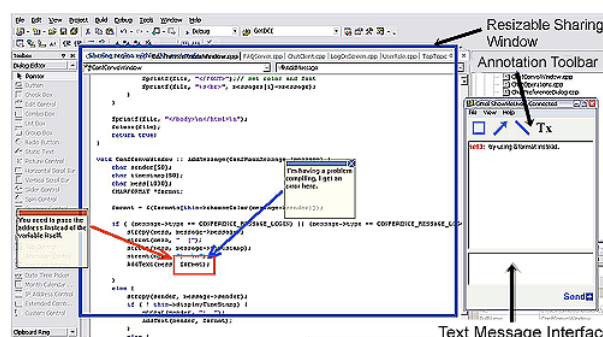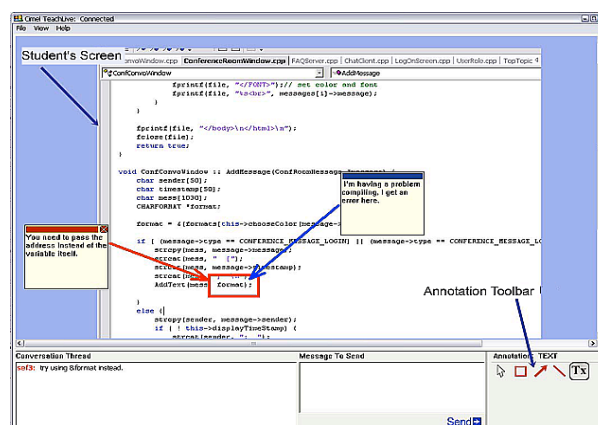

FIGURE 2
SHOWMELIVE

FIGURE 3
TEACHLIVE

Multimedia FAQ (mFAQ)

The Multimedia FAQ (mFAQ) works to bring together information and solutions recorded by the real time tools into a central repository where other students can access it when instructors are not available. The chat and TeachLive tools have the ability to save information to a file in the mFAQ. As seen in Figure 4, content in the database is organized by class and/or group and can easily be browsed in the same way as one would browse through a file system on their local computer (i.e. Microsoft Explorer). A user can browse through the directory structure and choose text conversations and stored ShowMe demonstrations to view.
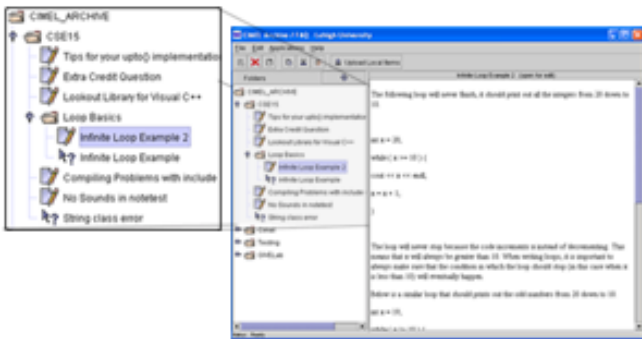
FIGURE 4
MULTIMEDIA MFAQ

User's Perspective of the System

We now examine how the problems outlined in the introduction would be solved using the Cimel Collaborative Tools. A more concise view of how the software is being used is given in Figure 5.

We begin with Alex's initial problem involving the Picture Control feature in MS Visual studio. Using the chat client, he contacts Professor Roberts who recognizes that he can show Alex how to perform this task by directly showing him how to do it via the TeachLive and ShowMeLive applications. He shows Alex how to do this without needing to schedule a face to face meeting. After the ShowMe session is complete, Professor Roberts uploads the demonstration to the mFAQ since it may be useful to others. Later, Jane encounters the same problem, and seeing that Professor Roberts is not online, posts her question to the assignment's discussion board. Alex later sees Jane's question and sends her an instant message telling her that Professor Roberts has entered a helpful recording into the mFAQ. Jane then logs into the mFAQ and finds the saved demonstration. After watching the demonstration in her DemoPlayer, she is able to complete the assignment.
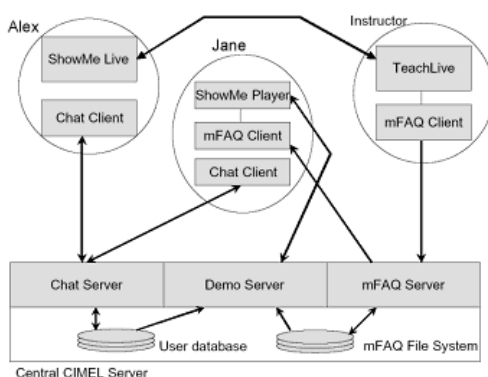

FIGURE 5
USAGE SCENARIO

Aside from the obvious benefit of Jane being able to complete her assignment, there are a number of other advantages to our software that are not necessarily obvious in this example. For instance, even if Professor Roberts had

been available for a meeting with Jane when she had her problem, he would have been able to immediately point her to the mFAQ, thus saving valuable time on his part. Also, Alex was kind enough to help Jane by responding to her question; however Jane could have just as easily checked the mFAQ herself. In another case, Professor Roberts might not have saved the demonstration to mFAQ; however Jane might have gotten in touch with Alex and had him show her the solution using a separate ShowMe session. Since Jane did not know Alex previously, this type of student to student communication would be unlikely to occur without a class specific instant messenger system such as CIMEL.

USER STUDIES

During the spring and fall of 2002 and spring 2003 we distributed the Cimel Collaborative Tools to students to obtain feedback on our system through a survey at the end of the semester. Student feedback was positive, with most students indicating that they felt the software would be very useful to them if made available in all their classes. Students also gave us important suggestions on how the user interfaces of the ShowMe and ContactList/ChatClient applications should be improved. During the 2003 academic year we worked to improve the usability issues and increase the reliability of the software.

Experiment

The current version of the Cimel Collaborative Tools was released to students at the beginning of the fall 2003 semester. The software was given out to students of an introductory computer science course. The class was made up of approximately 30 freshmen engineering students, two teaching assistants (TA's), and one instructor and consisted of lecture periods and a weekly three hour lab period.

The students in the course were randomly assigned into two groups. All students were given an introductory lesson in using the software at the onset of the semester and for the remainder of the semester were given alternating access to the software for four main programming assignments. We kept track of how often the students logged into the chat client and mFAQ (and what they accessed in the mFAQ) along with who they were "talking" to and for how long. We also kept track of which students contacted the TA's or instructor via email or during office hours. We administered a survey with questions about the effectiveness of the software to all students at the end of the semester.

We had three questions which we hoped this experiment would help answer.

- How do students use the software? How often do they log into the system, converse, access the mFAQ, and initiate ShowMe demonstrations?
- Do students feel the software is useful for them while completing assignments?
- Does the software improve student performance on the assignments?

TABLE 1

USAGE STATISTICS FROM FALL 2003

Usage Statistics	
Total Chat Users	22
Users involved in Conversations	11
Total Chat Conversations	8
Avg. Length of Conversations	1 hr, 14 m
Total ShowMe Sessions	5
Total FAQ Accesses	12

SURVEY RESULTS FROM FALL 2003

Selected Survey Results		
	%	Likert Avg
Use another IM often	75%	N/A
ChatClient was useful	45%	3.45
ChatClient would be useful w/ more participation	77%	3.92
mFAQ was useful	37%	3.05
mFAQ would be useful w/ more content	76%	3.77
ShowMe was useful	30%	3.1

Table 1 summarizes the most interesting results taken from the usage statistics. Half of the users took part in a chat conversation; conversations ranged from 10 minutes to over 2.5 hours with a steady stream of text messages (975 total message sent between the 8 conversations). Although 50% of the users took part in conversation during the semester, these eleven users were only involved in 8 different conversations. TA's did not spend as much time online as we had hoped, often logging on for less than an hour per week. Students often logged on for very short periods of time, indicating that students were indeed looking to ask questions but found no one online to ask. Students were more likely to log on at night, well after the instructor and TA's logged off. Only five ShowMe demonstrations were initiated, however after discussing the results with the instructor at the end of the semester, we believe this low usage is due in part by the fact that most of the students found this course relatively easy. This may have played a part in the low usage of the chat client and mFAQ as well. Further supporting the idea that the course was not challenging enough to warrant widespread use was the fact that both the instructor and TA's reported very few questions from students coming from other channels outside of class time (email, office hours, etc.).

Table 2 summarizes the survey results collected at the end of the semester. Students were asked to respond to the survey questions on a Likert scale, (ranging from Strongly Agree = 5 to Strongly Disagree = 1). When asked whether the tools proved useful during the semester, less than 50% of the students agreed, however when asked if the tools would be useful given more mFAQ content and more users online the majority of the users indicated the software would be very useful. Once again, we feel that if the course had been more challenging we might have seen more positive results in our survey.

Our third question was a more quantitative one, specifically whether or not the software improved student performance. There was no statistically significant relationship between usage and grades on assignments. We feel we won't be able to properly judge what effect the software has on student performance unless the software is more widely and frequently used throughout the semester.

Lessons Learned

The largest hurdles we face is in the evaluating our software. From survey results collected over three semesters, students have consistently indicated that the software would be extremely useful, and that the lack of adoption lies more in the lack of content and widespread participation. This is an understandable problem; no online collaborative tool will be immediately successful until the number of people using it reaches a critical mass [2]. Our survey results indicate that our experimental design in the fall of 2003 (alternating which students had the software) presented an additional obstacle in class-wide adoption of the software. Students want to use the software, however in the future we need to increase the number of students who have access to it and be more aggressive in encouraging TA's and instructors to be online more often and provide more content in the mFAQ. There is evidence that suggests that this type of adoption problem is somewhat common during the development and implementation of groupware, specifically in the workplace [5]. In many cases groupware applications are not adopted in practice because one segment of the target audience does not benefit from the application as much as another. In our case, students perceive a payoff in using the software; however usage rates by instructors and TA's curtails student participation. Additionally, our survey results and discussions with the instructors and TAs suggest that the introductory computer science course may not have been challenging enough to warrant widespread use of the collaborative tools. We are currently evaluating the tools in an upper level course in order to gauge if usage increases when students are faced with more advanced assignments.

CONCLUSIONS

We believe that the Cimel Collaborative Tools offer many advantages over existing groupware communication tools in an academic setting. The text messaging tool (ContactList/ChatClient) provides a user interface that meets the expectations of students while also removing some of the negative aspects of using a publicly accessible IM service (privacy issues, user anonymity, distractions from friends outside of class, etc.). ShowMe applications more closely follow the roles of the instructor and student, providing the instructor with an "over the shoulder" view of the problem the student is having and promoting a "Learn by Doing" approach with respect to the student. At this time we still face the challenge of getting students and instructors to maintain their

TABLE 2

usage of the system and plan on broadening the availability of the software and encouraging instructors and TA's to make the software a more integral part of their courses. Adoption of the software will be our primary goal in the short term. In the longer term, we also plan to implement a ShowMe demonstration editor, allowing instructors to edit the ShowMe session they save before uploading to the mFAQ and a ShowMe authoring tool which would allow an instructor to record his/her own demonstration before a question arises.

REFERENCES

[1] Blank, G. D., Pottenger , W.M., Kessler, G.D., Roy , S., Gevry , D. R., Heigl, J. J., Sahasrabudhe , S. A., Wang , Q., "Design and Evaluation of Multimedia to Teach Java and Object-Oriented Software Engineering". *Proceedings of the 2002 American Society for Engineering Education Annual Conference & Exposition*, NSF Showcase, June 2002.

[2] Ehrlich, S. F., "Strategies for encouraging successful adoption of office communication systems". *ACM Transactions on Information Systems (TOIS)*, Volume 5 Issue 4, October 1987. pp 340-357.

[3] Finholt, T.A., Rocco, E., Bree, D., Jain, N., Herbsleb, J.D., "NotMeeting: a field trial of NetMeeting in a geographically distributed organization". *ACM SIGGROUP Bulletin*, Volume 20 Issue 1. April 1999. pp 66-69.

[4] Grinter, R. E., Palen, L., "Instant messaging in teen life". November 2002. *Proceedings of the 2002 ACM conference on Computer supported cooperative work*. pp 21-30.

[5] Grudin, J., "Why CSCW applications fail: problems in the design and evaluation of organization of organizational interfaces". *Proceedings of the 1988 ACM conference on Computer-supported cooperative work*, January 1988, pp 85-93.

[6] Handel, M., Herbsleb, J.D., "What is chat doing in the workplace?" *Proceedings of the 2002 ACM conference on Computer supported cooperative work*. November 2002, pp. 1-10.

[7] Isaacs, E., Walendowski, A., Whittaker, S., Schiano, D.J., Kamm, C., "The character, functions, and styles of instant messaging in the workplace", *Proceedings of the 2002 ACM conference on Computer supported cooperative work*. November 2002, pp 11-20.

[8] Nardi, B.A., Whittaker, S., Bradner, E., "Interaction and outeraction: instant messaging in action". *Proceedings of the 2000 ACM conference on Computer supported cooperative work*. December 2000. pp 79-88.

[9] Wang, Q., Kessler, G. D., Blank, G.D., Pottenger, W.M., "Demonstration Tools for Collaborative E-Learning", *Proceedings Companion of the ACM Conference on Computer Supported Collaborative Work (CSCW 2002)*, New Orleans, LA, Nov. 2002.

[10] AOL Inc., AOL Instant Messenger. http://www.aim.com/index.adp

[11] Centra Inc., http://www.centra.com

[12] MSN Messenger (Microsoft). http://messenger.msn.com/

[13] NetMeeting (Microsoft). http://www.microsoft.com/windows/netmeeting/