A Laboratory Experience for Teaching Participatory Design in a Human-Computer Interaction Course

Jerry B. Weinberg, Mary L. Stephen
Southern Illinois University Edwardsville / Saint Louis University

I. Introduction

The ability of computer technology to improve productivity and enhance quality of life rests squarely on how well the technology application fits our conceptual understanding of how things work[1]. While it is important for a software product to provide the necessary functionality to perform its intended use, it is also important that this functionality be presented in a manner consistent with the user's understanding. While the software programmer/engineer is concerned with developing reliable, robust, and maintainable software, the software designer is concerned with creating products that fit within the user's overall activities, enhance productivity, and produce a satisfying experience[2, 3]. Left to their own devices, computer programmers are apt to take a "systems-centered point of view," concerned with "how the software works and what parts of it do what" [1, p. 217-218]. While it is important for a software product to provide the necessary functionality to perform its intended use, it is also important that this functionality be presented in a manner consistent with the user's understanding. For example, the DOS operating system provided all the necessary functionality for managing file and folders from a command line. But the desktop metaphor of Apple's Macintosh and Microsoft's Windows transformed the personal computer operating system into a product that could be easily used by the most non-technical users because its presentation fits their conceptual understanding of managing files and folders.

In the area of Human-Computer Interaction (HCI) research, a number of approaches have evolved to meet this challenge. These include User-Centered Design, Participatory Design, and Customer-Center Design. Though they differ in techniques, the common factor is interacting and collecting data from users as a basis for design. Each finds ways to interject the designer in the user's world and the user in the designer's world in order to develop a shared conceptual model of the task and the context in which it is being done[4]. This paper focuses on the development of a curriculum for a HCI course that uses a practical, experiential learning environment for this important aspect of design. In particular, this paper describes the inclusion of a long-term design project with volunteer users and the creation of a low cost lab to support team design activities and user interaction in the HCI course[*].

II. Overview of HCI Course

In the Computer Science curriculum at Southern Illinois University Edwardsville (SIUE), the HCI course is a required course. Course enrollment is usually between 15 and 30 students. The prerequisite to the HCI course is "Interaction Programming," a course that provides the students with an understanding of event driven programming, graphical user interfaces (GUI), and one

[*] For course materials and additional information please visit www.cs.siue.edu/hci

language to program GUI's. This is a second language course for the students. Students tend to take the HCI course in their junior year just prior to the Senior Project Capstone Course.

The HCI course provides students with the basis for performing the design work in their capstone projects. The capstone projects are solicited from the University and local community. Because these are actual projects with non-computer professional users it is important that the students understand how to interact, gather data, and design with users who do not have a computing background.

The HCI course is structured around the steps in the Contextual Design approach[5]:

- User interviewing & observation
- Data modeling & model consolidation
- Brainstorming
- Paper prototyping
- Usability testing

Contextual Design relies on ethnographic techniques from anthropology[6, 4, 7, 8]. Ethnography is a method of research in which the investigator gathers data within the context of the natural setting. Throughout the Contextual Design process, members of a design team engage in activities requiring the same skills used by ethnographic researchers[7]. The use of ethnographic techniques in the design process helps bridge the communication gap between designers and users to produce a product with functionality more closely aligned with the user's understanding. Like other notable areas of computer science, ethnographic skills must be experienced and practiced to fully learn their potential as well as their theoretical underpinnings[9]. Two aspects of the redesigned curriculum for the HCI course have focused on students' development of these skills. First, materials and exercises that focus on observation, interview and data interpretation are now part of the course. Second, students in the course have the opportunity to use these skills with real potential users of their term-long design project.

III. Term-Long Design Project

In the HCI course, teams of three to four students are assigned a term-long software design projects. Students in introductory computer science courses are recruited to serve as the potential users of the software. This is an approach similar to the way upper division psychology courses teach empirical research methodology by soliciting voluntary subjects from lower division courses. The student volunteers are offered extra credit for participation. The tasks to be performed by the software project are universal enough that the student volunteers will have some experience with them. For example, one project focused on creating a time management system geared toward academic studies and another focused on an application for creating academic schedules.

The use of these volunteers provides members of the design team with data from potential users to develop, validate, and refine their designs. This affords the students a learning experience of interviewing potential, non-technical users and collecting data as the basis for design. In the design project, each HCI student is required to interview/observe two potential users selected from the pool of volunteers. So, a design team of three will have data gathered from six people.
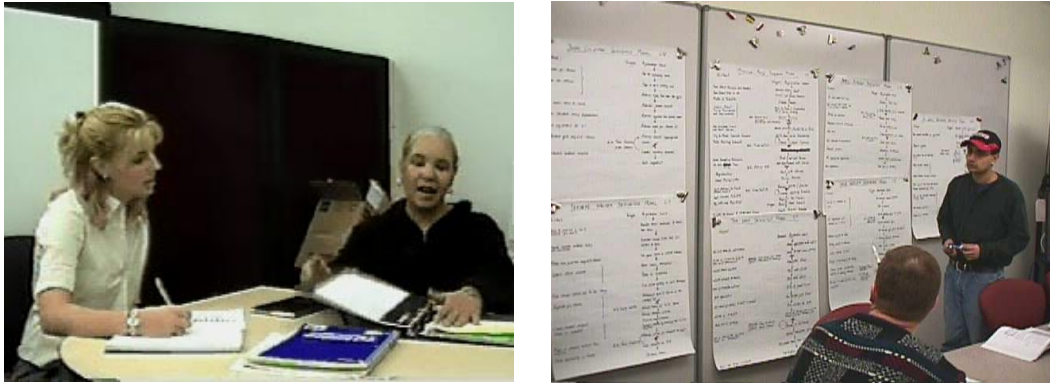
Figure 1: Student conducting an interview and design team modeling user data.

Each interview results in a set of descriptive field notes that the design team uses to create models of the users. A variety of models show different aspects of the user's activities revealing communication patterns, work organization, and work strategies (See Figures 1 and 2). The team uses the work models to recognize implications for design and to create an initial design during a team brainstorm session.
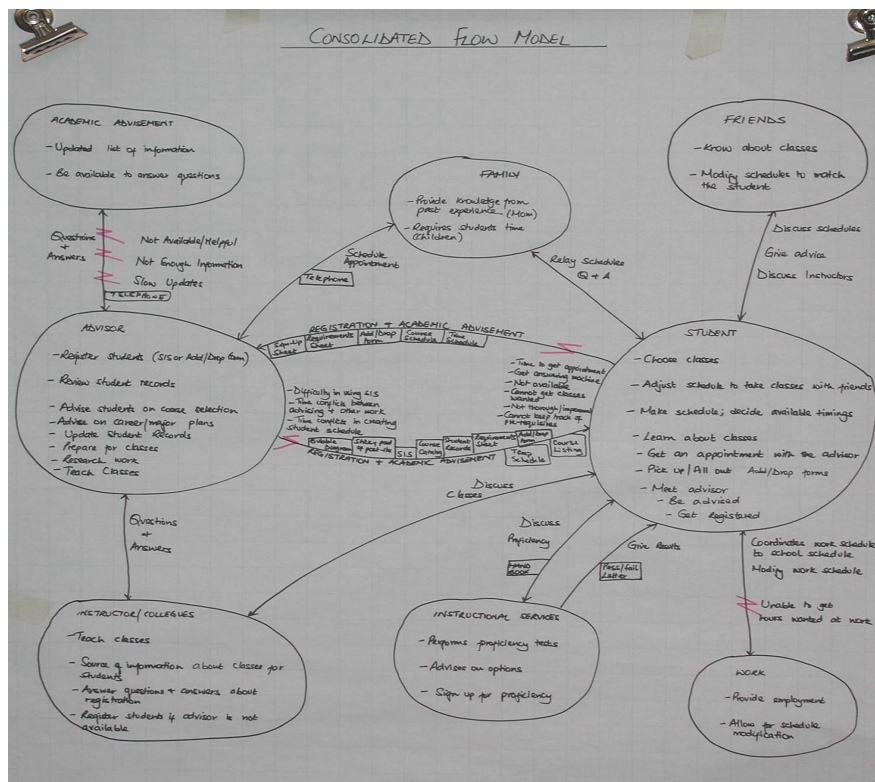

Figure 2: Example of work models created

From the design ideas the team prepares a paper prototype of the design. Paper prototyping is a quick way to envision the entire application and get significant user feedback very quickly[10] (See Figure 3). The design team then tests the paper prototype with three of their original interviewees. Here users are asked to perform tasks from scenarios while one design team

member "plays" computer by changing the screens. Others design team members take notes about when the user has difficulty accomplishing the task. This provides members of the design team with both a way to refine their design and to validate their ideas. In presenting a final design at the end of the course team members regularly explain features they have added or changed based on input from their users during the paper prototyping sessions.
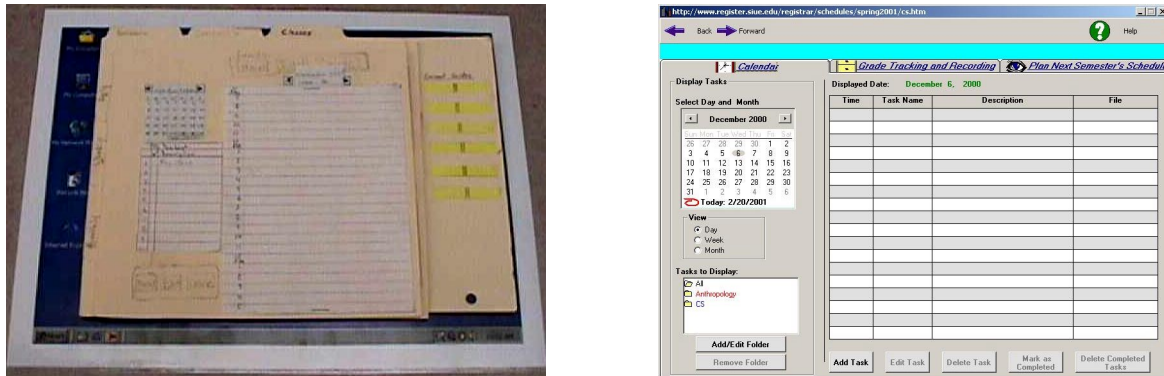

Figure 3: Paper prototype and final high fidelity prototype

IV. Design of Lab to Support Contextual Design Process

An HCI lab was built to support the contextual design process. The lab is a split room configuration with a Design Team "War Room" and a User Interaction Room for interviewing, paper prototype testing, and usability testing.
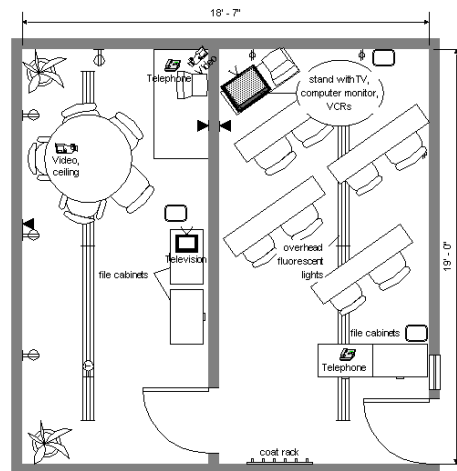

Figure 4: Original conceptual design

IV.A. Design War Room

This room is intended for team design and brainstorming sessions. The Design War Room has 3 white board walls and 1 pin-up wall. Teams use a **"*working-on-the-wall*"** approach to meetings. This allows everyone to visualize what is being done, allows everyone to easily contribute, and it drives a shared understanding amongst the team members. The writing walls have a metal backing so that magnets can be used to hold models and design ideas. Work is done on large

sheets of poster paper (See Figure 5). Each time the team meets they put up the work that has been done so far so that they are *immersed in the data*. This allows team members to **"***walk the wall***"** as a way to keep in mind the interpretations of the data. It also creates a group memory or group consciousness to recall what the team has accomplished before. The poster paper approach allows multiple teams to use it similar to a dedicated design room.

Figure 5: Design War Room

The tables in the Design War Room are easily movable to accommodate different configurations, such as for team conference meetings or videotape viewing.

IV.B. User Interaction Room

This room is intended for design teams to interact with users through interviewing, paper prototype testing (low-fidelity), and usability testing (high-fidelity). One or two of the design team members can be interacting with users in this room, while other members can be observing over the closed-circuit cameras in the Design War Room (See Figure 6). The monitor in the Design War Room is slaved to the computer in the User Interaction Room.
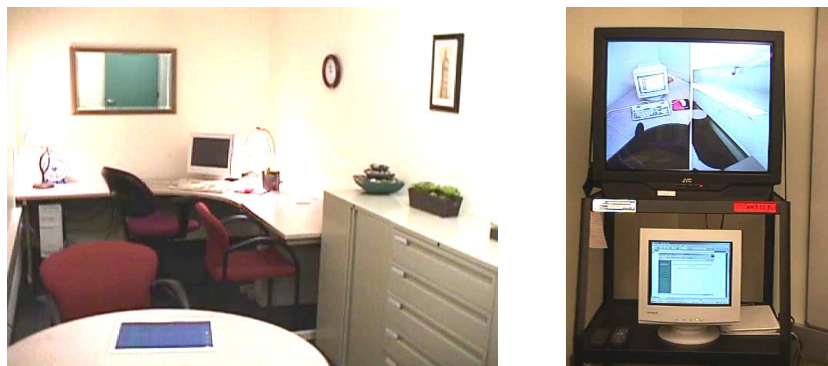

Figure 6: User Interaction Room and observation equipment

The user sessions are video taped to allow teams to review the sessions and gather details as needed. A dome camera provides a view of the users screen or can be rotated to get a view of the table for interviewing or paper prototyping (See Figure 7). A second fixed camera provides a

close-up view of the user to capture facial expressions and body gestures. The monitor can be split between both cameras or it can be put on one of the two camera views.

Figure 7: User observation cameras

While the rooms are well insulated, team members in the observation area are instructed to keep comments in a quiet tone of voice. When users are brought into the lab, a partition is placed so that the user cannot see other members of the design team (See Figure 8). This helps reduce user's anxiety.

Figure 8: Observation room partition

The construction cost of the HCI Lab was approximately $20,000 (USD). This includes the cameras and monitoring equipment, cost to split the room, cost of the writing walls, and the computers. We have explored a few alternatives to reduce this cost significantly. For example a single pan camera could be used instead of two cameras. To capture the user's reactions a mirror placed by the monitor would reflect the user's face into the camera's image. Some of the activities can also be accomplished even if a dedicated room cannot be found. For example user interviewing and paper prototype testing could still be accomplished with a camcorder mounted to a tripod and any quiet room.

V. Conclusion

The revised HCI curriculum with the inclusion of ethnographic techniques, term-long software design project using volunteer users, and the use of the HCI laboratory has increased students' understanding and appreciation of participatory design. In the words of two different students, "this course has made me look at my job in new ways." Over the three semesters of this study,

each group completed all stages of the conceptual design process to successfully design a software product based on user input. Preliminary results of studying long-term attitudes toward design indicate that the approach taken in the revised HCI course seems particularly successful in raising student awareness of the importance of the user as a partner in the design process. In interviews conducted with students enrolled in the Senior Project Capstone course, students who took the revised HCI course reported using many of the ethnographic skills and aspects of contextual design process learned in the HCI course when designing their capstone project. Students in both the HCI course and students in the Senior Project Capstone course use the HCI lab regularly.

Bibliography
1. Landauer, T. K. (1995) The Trouble with Computers: Usefulness, Usability, and Productivity, The MIT Press, Cambridge, Mass.
2. Winograd, T. (1996) "Introduction" in Bringing Design to Software, ACM Press, New York, NY, xiii-xxxv.
3. Kapor, M. (1991) "A Software Desing Manifesto: Time for a Change", Dr. Dobb's Journal, 172, 62-68.
4. Roberge, J. (1991) "Embedding Laboratories Within the Computer Science Curriculum." Papers of the 22nd SIGCSE technical symposium in Computer Science Education. 23(1), 6-10.
5. Beyer, H., and Holztblatt, K. (1997) Contextual Design: A customer-centered approach to systems designs, Morgan Kaufman Publishers, San Francisco, CA.
6. Huges, J., King, V., Rodden, T., and Anderson, H. (1995) "the Role of Ethnography in Interactive Systems Design," Interactions, 2(2) 56-65.
7. Rose, A., Shneiderman, B., and Plaisant, C. (1995) "An Applied Ethnographic Method for Redesigning User Interfaces," Symposium on Designing Interactive Systems: Processes, Practices, Methods, & Techniques (DIS '95), G. Olson & S. Schuaon, eds., ACM Press, 115-122.
8. Simonsen, J., and Kensing, F. 919970 "Using Ethnography in Contextual Design", Communications of the ACM, 40(7), 82-87.
9. Mueller, J., and Kuhn, S. (1993) "Participatory Design", Communications of the ACM, 36(6) 24-28.
10. Rettig, M. (1994) "Prototyping for Tiny Fingers", Communications of the ACM, 37(4) 21-26.

JERRY B. WEINBERG
Jerry B. Weinberg is an Assistant Professor in the Computer Science Department at Southern Illinois University Edwardsville. He teaches courses and conducts research in artificial intelligence and human-computer interaction. Dr. Weinberg received a B.S. in Nursing from Indiana State University (1984), a B.S. in Computer Science from the University of South Carolina (1988), and his Ph.D. in Computer Science from Vanderbilt University (1996).

MARY L. STEPHEN
Mary L. Stephen is coordinator for technology and learning at Reinert Center for Teaching Excellence, and associate professor of Educational Studies at Saint Louis University. Her research interests include the use of ethnography to study computer use in the classroom. She has a B.A.degree in Mathematics from D'Youville College, an M.A. degree in Mathematics from the University of Detroit, and a Ph.D. in Education from Saint Louis University.