

STUDENT'S EVALUATION OF WEB-BASED LEARNING TECHNOLOGIES IN A HUMAN-COMPUTER INTERACTION COURSE

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Abstract: The human-computer interface (HCI) field is constantly changing and designers are challenged to develop simple interactive systems implemented through sophisticated technology. At Ben-Gurion University, the introductory HCI course was originally taught in a face-to-face mode and covered theoretical knowledge on HCI theories, principles and design, and practical experience in designing and evaluating websites. When it became apparent from students' course evaluations that they expected the HCI course to provide them with more hands-on experience with different types of interaction, communication devices, and design dilemmas, the course was redesigned. The new course combines face-to-face lessons, e-learning sessions and web-based collaborative projects. While there is still room for improvement, student's evaluations show significant increase in satisfaction with the course.

1 BACKGROUND

The Human Computer Interaction course is taught during the third year of a four-year program (8 semesters) in Information Systems Engineering at Ben-Gurion University of the Negev (<http://www.ise.bgu.ac.il>). The ISE curriculum is structured to provide students with the concepts and tools that form the fundamental base of knowledge essential to computer information systems professionals in today's modern technological environment. Graduates of the ISE Department are provided with the tools to perform diverse tasks in the IS field such as specifying the information needs of users and managers in organizations; performing feasibility studies of information systems; analyzing and designing software, data bases and user interfaces; and developing prototype systems by application of appropriate analysis and design methodologies and CASE tools. Other tasks include programming, implementation, maintenance and administration of information systems.

Due to constant changes in the field, human-computer interface designers are confronted with the development of easier interactive systems based on sophisticated technology. Unlike the common courses taught in computer science and information

systems, which are topic oriented, HCI is an interdisciplinary field. It requires the understanding of theories and principles of design and development of interactive systems through different technologies. It demands also awareness to psychological and cognitive sciences and evaluation issues, as well as practical development skills to implement interfaces to work properly with a variety of users.

For several years we taught a Human Computer Interaction Introductory course in a face-to-face mode. The course provided theoretical knowledge on HCI theories, principles and design topics and practical experience web sites design and evaluation.

The objectives of the face-to-face course were:

- Learn basic concepts, theories and approaches in the HCI field.
- To develop a design point of view. To acquire the necessary skills to analyze interaction problems on a technical, a cognitive, and a functional basis and to propose plausible improvements based on practical guidelines, theories and research findings.
- Developing a framework for orderly thinking in formulating, clarifying, implementing and evaluating HCI designs for interactive systems.

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- Be familiar with frontier technologies, tools and methodologies to implement and evaluate user interfaces for different interactive systems using the variety of tools and methods that were presented during the course.

The course covered the following topics:

- Principles and theories of the human-computer interactive systems
- Characteristics of the human information processing
- User Centered Design and Evaluation approaches, methodologies and tools for HCI
- Software architectures and standards for user interfaces
- Interaction Styles and Design topics for web-based systems
- Designing and developing interfaces for diverse input and output devices
- Supporting user errors – Design issues, documentation, help and tutorials
- Advanced topics – CSCW, e-learning, search and visualization

Students submitted three assignments during the course. The first assignment focused on the evaluation of an existent website. The second assignment required the design of a new website applying the principles of design acquired during the course. In this assignment students supplied the rationale for designing the new website and performed a "hands on" exercise using standard development tools (visual basic, Java script, HTML). The third assignment required the assessment of the new website (performed in the second assignment) implementing methodologies of usability testing. Students selected a partner to perform the assignments.

Students attended classes once a week. During the classes the tutor (a senior staff member) taught the course topics assisted by PowerPoint presentations. Students' interaction with the lecturer was mainly through questions asked during the class. A course assistant (a graduate student) was available during reception hours. The assistant helped students according to students' initiative.

The course had an additional website. The website included: learning materials (presentations), the syllabus and assignments instructions.

Annual students' evaluations revealed that they expected from the HCI course to provide them with more hands-on experience on different kinds of interaction, communication devices and design dilemmas than those acquired during the course. Besides, they expected the course to be more "interesting". During interviews conducted with volunteer students they expressed their willingness

to experience new tools and modes of interaction in addition to those taught during the course, such as collaborative applications and e-learning.

We decided to redesign the Human Computer Interaction introductory course intending to meet these expectations.

2 THE NEW COURSE

The new Human Computer Interaction introductory (HCI 2002/3) course was taught at the Information Systems Engineering Department in Ben-Gurion University. The course objectives and topics were the same as those in the former course (see prior section). The HCI 2002/3 course had a new major improvement; the addition of a website which included a collaborative workspace that allowed the students to interact with other fellow students and the course staff. The course site enabled the students to experience different kinds of interactions with various technologies such as e-learning and collaborative environment; to practice the theoretical principles and the technology involved; to design prototype systems implementing both their personal experience and the theoretical and technical knowledge acquired during the course. The course combined three kinds of learning methods: (1) face to face lessons; (2) web-based lessons and (3) web-based design and collaborative evaluation projects. A hundred and fifty students have participated in this course.

We will describe the implementation of web-based lessons and collaborative technologies in the HCI 2002/3 course and present the students' evaluation results.

2.1 Implementation of interactive lessons in the HCI 2002 course

The HCI 2002/3 course was delivered in the Mixed Mode (Harasim, 2000a, 2000b) (where students participated in F2F (face to face) lectures and Interactive Distance Learning techniques). The Mixed Mode of web-based learning employs networking as significant portion of a traditional classroom or distance course. It is distinguished from the adjunct mode (which typically refers to the use of the network as an enhancement but not as a required or graded component of course activity) by the fact that networking is fully integrated into the curriculum. The networking activities constitute a regular part of the course and are included on the course grade. Mixed mode learning has many variations. It may be used for one or more major

activities in a traditional face-to-face or distance mode course, such as small group discussions, seminars, and group projects. An example is an undergraduate course in Communication at Simon Fraser University, Canada (<http://www.sfu.ca/index3.htm>) that uses six weeks of a thirteen-week course for online student-led seminars; the other seven weeks are held as face-to-face lectures and tutorials. The use of online seminars in a face-to-face class is a common application of mixed mode delivery. Usually, online seminars enable all students to participate, something impossible in a small face-to-face classroom, and certainly impossible in large undergraduate classes.

Harasim (2000) reported from data collected in the Virtual-U project (<http://virtual-u.cs.sfu.ca/vuweb.new/vuproduct.html>) that in mixed mode courses, the level of active student participation and interaction is significant.

As in the Communications course held at Fraser University (Ramiller, 2002), in the new HCI 2002/3 course six weeks of a thirteen-week course were conducted as web-based lessons + virtual collaborative projects; the other seven weeks were held as face-to-face lectures and tutorials.

Students interacted on a one-to-one basis on the interactive lessons in the course site. The course had six interactive lessons. Six topics, one each week, were learned in each interactive lesson. Students accessed the interactive lesson through the course website. In each interactive lesson a new topic was presented and students were requested to perform various tasks and to answer questions based on the studied topic. For each topic, the students were required to read relevant articles, book chapters or web material linked through the interactive lesson. The objective was to provide the students with basic knowledge and understanding on the concepts and ideas discussed during the interactive lessons.

The overall length of an interactive lesson was approx. 30 minutes. However, to complete all the tasks, usually students started an e-lesson and stopped after a while. It was not allowed to introduce changes to completed tasks (to diminish plagiarism). Each time a student came back to the same lesson s/he was able to continue from the place they stopped.

The topics learned through the interactive lessons were assessed with diverse techniques. Students defined concepts, searched for relevant examples and uploaded their URL, proposed their own solutions and answered open and multiple-choice questions. All the user data and behavior during the interactive lesson was recorded. The course assistant checked the open questions, while closed questions were checked automatically,

rendering a combined grade for each lesson. Finally each student got a mark for all the interactive lessons.

Students were required to fill a web-based feedback questionnaire for each lesson. This task was voluntary. We encouraged students to fill it; however, no grades were given for this task in order not to bias results.

After finishing the lesson the student got an email confirming that all the tasks on that lesson were submitted. After grading the whole lesson, an automatic mail was sent to the student with the corresponding grade.

2.2 Implementation of Collaborative Assignments in the HCI 2002/3 course

The standard one to one interaction between user and computer has been challenged during the last years by the development of distributed and collaborative applications. Collaborative learning is defined as a learning process that emphasizes cooperative efforts among faculty and students. It stresses active participation and interaction by both, students and instructors (Bouton. & Garth, 1983; Bruffee, 1984).

The collaborative learning approach is considered an interactive approach (Alavi, 1994). It can be treated as a method that encourages students at various performance levels to work together toward a common goal (Johnson, 1981; Johnson & Johnson, 1975). Harasim (1990) indicates that "Collaborative learning" is fundamentally different from the traditional "direct-transfer" or "one-way knowledge transmission" model in which the instructor is the only source of knowledge or skills. In collaborative learning, instruction is learner-centered rather than teacher-centered and knowledge is viewed as a social effort, facilitated by peer interaction, evaluation and cooperation. Therefore, the role of the teacher changes from the transferring of knowledge to students to being a facilitator in the construction of the student's own knowledge (Hiltz & Benbunan-Fich, 1997).

Asynchronous Learning Network (ALN's) is a teaching and learning environment located within a Computer-Mediated Communication (CMC) system designed for anytime/anyplace use through computer networks (Hiltz, 1994; Hiltz & Wellman, 1997). The asynchronous nature of the interaction leads to new paradigms for teaching and learning. They state that the most important element for an ALN learning environment that supports collaborative learning and relates to the "social construction" of an interaction

environment is the appropriate expectation and norms of interactions. In particular, the instructor role must be re-conceptualized. The instructor needs to encourage students to look upon their interaction with their peers as valuable resources for learning, rather than focusing on memorizing lecture-type material presented by an instructor.

Ramiller (2002) points out that the use of a project assignment helps to promote active learning through hands-on engagement within a collaborative learning context. He implemented an innovative approach, the Virtual Interactive Project (VIP) that explores the middle ground between field projects and text-based projects in an effort to achieve some of the advantages of both. The project evolved through web-based and email interaction between students and a "virtual client" representing the firm in the case.

Beyond the common principles, which guide the development of all human computer interfaces, specific principles involve the development of the same interfaces to enable collaboration through different devices. However, most of the students have no prior experience with those technologies as users. We intended to provide the students with the experience of cyber-work in the web with different tools.

We implemented an Asynchronous Learning Network (ALN's) as a teaching and learning environment, which included e-mail, public conference (forum) and private conference facilities (suitable for multiple group projects) (Clark, 2000, Harrasim, 1991; Lehtinen et al., 2000) to enable active collaboration of several group members participating in the same assignment. All the interactions within the forums were saved in the course database.

The course population (150 students) was divided into 15 groups of 5 pairs of students each one (ten students in each group). The students performed two collaborative assignments, with the same structure but on different topics. Students had five weeks to elaborate each one of the two collaborative assignments and perform all tasks. In the first assignment, each group received a description of a different desired system or tool. The objective of the first assignment was experiencing with the phases of a user centered design project. Each phase was assigned to one pair of students. The first pair was responsible for performing the exploration phase; the second pair gathered and analyzed the user requirements. The third pair was in charge of the design and functionality of the system. The fourth pair defined the usability testing based on Nielsen's usability parameters (Nielsen, 1993). The last pair prepared a comprehensive presentation that

summarized all the pairs' activities and products and presented it to the class in a face-to-face meeting.

The objective of the second assignment was to create an interactive lesson on the web. The assignment was divided into 5 tasks where each team was in charge of a different task, same as in the first collaborative assignment. The assignment's tasks were either technical such as: building a DB, developing a website or code writing for the interactive lesson or conceptual tasks e.g. exploration, bibliography review, writing and designing the lessons' content. Each group prepared an interactive lesson on a different subject.

In addition, it was clearly emphasized by the course instructors that the group members must collaborate, as the product of one task will act as a building block for the following tasks.

To facilitate communication between students, the course website interface was developed in Hebrew. In order to enable collaboration between the group members, each group was provided with a workspace within the course site. At the group workspace a full description of the project was available. All students in the same group had to be acquainted with all the subtasks of the assignment. For each one of the two group assignments, each pair within the group had to select a task from the list of available tasks, via the collaborative environment. Students had two roles: as sub-task leader for one week, and as other students' tasks reviewer for the rest of the time. While performing as subtask leaders, students work in small teams, with one peer, to prepare and present the topic, moderate the discussion for a week and upload a written assignment on their sub-task. When a document was uploaded all the members of the group received an automatic message from the system including the name of the team, which submitted a file, and the name of the file. Students uploaded articles, pictures, sound files, forms and excel sheets among others. Other students had to read and review the files and comment on them. There was no limitation on the number of working files each subtask team could upload. However, at the submission deadline, just one integrated file was permitted for each subtask.

3 STUDENTS EVALUATION OF THE HCI 2002/3 COURSE TEACHING METHODOLOGIES

3.1 Goals and Rationale

The purpose of the evaluation was to test students' satisfaction from the different teaching methodologies implemented in the course. We decided to test mainly students' preferences, a subjective measurement, because we had no influence on their opinion. Moreover, being this course one with many tasks to perform each week, requiring considerable student's responsibility, this fact may have a negative influence on student's course evaluation. We opted for this unfavorable situation instead of relying on grades evaluation. Basing our evaluation on course grades may have been unintentionally biased, considering that those who assigned the grades are the course teaching staff.

Nevertheless we compared the final grades distribution from this course with former ones (two years ago) and found no significant difference. Students read the same bibliography (in the mixed model course they read added references). The grade components were different; therefore no other comparison was possible.

This comparison was performed as a validity test. Having similar marks, the question remains: What did the students preferred? How did they evaluate the different learning experiences they got? And, did they enjoy the learning process more?

3.2 Methodology

After each lesson students were requested to fill an online feedback form at the course website. The questionnaire scale range is: 1 (totally disagree) - 5 (totally agree). Form filling was encouraged but voluntary. In addition, a face-to face open feedback discussion was conducted at the end of the two collaborative assignments students' presentations.

The following is a summary of the feedback questionnaire. The total number of questionnaires filled was 678.

The average participation per lesson type is the mean rate of voluntary evaluation form- filling relative to the total number of students enrolled in the course (150) not related to other types of lessons. Table 1 show that students rated the e-learning sessions three times more than the F2F lessons and the collaborative learning.

We expected the students to have different preferences towards the three types of lessons (see Table 2). We grouped the negative evaluations (1-2) and the positive ones (4+5). Overall answers to all the questionnaires were 8126 (approx. $677 \cdot 12$). We performed Chi2 test of association. We found that students preferred the F2F lessons significantly more than expected, compared to the e-learning lessons (Chi2 26.88, $df=4$, $p < 0.001$). However when we analyze all the rates given to the e-lessons alone, most of the students significantly preferred to study HCI topics through web based learning (Chi2 for goodness of fit test= 247.7848, $df=2$, $p < .001$).

Table 1: Average Percentage of Evaluation Form filling by Lesson Type

| Lesson Type | Average participation per lesson type | Relative percentage of answers per all feedbacks (678) |
|-----------------------|---------------------------------------|--|
| F2F Lessons | 21.50% | 19.02% |
| Interactive Lessons | 66.00% | 73.04% |
| Collaborative Lessons | 18.00% | 7.94% |

Table 2: Students' evaluation toward the three types of lessons.

| Evaluation | F2F lessons | Interactive Lessons | Collaboration lessons | Total answers |
|----------------|-------------|---------------------|-----------------------|---------------|
| Disagree (1-2) | 315 | 1543 | 160 | 2018 |
| Neutral (3) | 480 | 1879 | 202 | 2561 |
| Agree (4-5) | 753 | 2518 | 276 | 3547 |
| Total Answers | 1548 | 5940 | 638 | 8126 |

Chi2 = 26.88450469, df= 4, p<0.00

4 DISCUSSION AND CONCLUSIONS

The revised HCI introductory course for Information Systems Engineering was first introduced during winter 2002/3. It combined face-to-face lessons, e-learning sessions and web-based design collaborative projects. The philosophy behind the course was to give the students, besides the domain knowledge, the opportunity to experience new technologies by performing practical work through systems they might design in the future (such as e-learning and collaborative work).

Student's evaluations showed significant satisfaction from the new course methods, however, new methodological and practical problems should be considered.

First, it is important to mention that this kind of course requires a considerable effort from the course academic, administrative and technical staff. The course involves three phases of development: preparation, testing and delivery.

All the course material should be prepared in advance. Besides the presentations for the F2F lessons, the web lessons require many hours of preparation. The collaborative environment is a full development project demanding continuous technical support before and during the course delivery.

Web lessons should be tested as well as the collaborative environment. Communication difficulties may appear unexpectedly, disturbing the course schedule.

During the course delivery, the course staff is engaged many hours with course activities. Students are active beyond working hours, during weekends and holidays, expecting from the course staff to respond in a timely fashion.

Students ranked highly the F2F lessons. Although this result is based on a relatively small number of students that voluntarily filled the students feedback forms (an average number of 32 students graded the F2F lessons), it is corroborated with the high participation rate in these lessons (no mandatory assistance was required). The course presentations were public at the course website; therefore, it seems that students appreciated the F2F discussions involving personal and social interaction. This result should be verified in future studies with a larger number of students.

One of the most exciting results in this study was the high degree of voluntary feedback filled up by the students to the e-learning lessons. Students were encouraged to do so, however, no grade reward was accredited. An average of 99 students (from 150) filled up their feedback to each e-learning lesson. Moreover, Chi2 for goodness of fit test showed that more students evaluated these lessons significantly higher than expected ($p < .001$).

Student expressed that the course material was well organized and it was easy to track course presentations on the web.

A smaller number of students evaluated the collaborative lessons. There are several possible reasons for this finding. The first, and most probable, is that students had an opportunity to give F2F feedback by the end of each collaborative assignment presentation lesson. Student expressed that it was easy to communicate and perform the required tasks within the virtual environment. The feedback on the collaborative assignments was that at the beginning it was hard to accept that they have to cooperate in order to get the work done. Few students felt it as "unfair" since dedicated responsible students should rely on inputs of less successful ones. During the process the students realized that the only way to feel more confident with other's inputs is to be in touch, to give feedback

on each other's documents or outputs and check if the feedback was reflected in the revised documents. Few students questioned the need for this kind of assignment due to its complexity. Other students replied that in order to succeed in a project in their workplaces (mostly technological and software companies) they have to cooperate within their teams and sometimes with other teams. They stated that collaborative assignment encouraged individual thinking as each team is in charge on leading a task and in addition, each team is committed to the success of the whole assignment. Another feedback was on the group structure, students complained that they were missing the instructor role while other groups replied that they have nominated a group chair that was in charge on the timeline and to encourage the group members. Most of the students expressed that during the first assignment they learned how to collaborate and that the second assignment was easier on this aspect (but more difficult on the subject matter).

Another possible reason for the low rate of feedback form-filling on collaborative lessons is that students gave feedback to each other within the collaborative environment many times during the assignment period. They might have felt that they did their job already.

It is worthy to notice that few students didn't like the e-learning or the collaborative lessons. This finding may have two possible implications about the HCI 2002/3 course. One the one side, the course does not match all types of students. Some students may prefer to work alone. For those students the collaborative assignment may be very difficult. On the other side, the HCI 2002/3 course is very varied, enabling students with different learning styles to perform better in their preferred kind of lesson.

We conclude that the HCI 2002/3 course enabled students to achieve several goals: to learn theoretical principles, technologies, development and evaluation methodologies through the F2F and web-based lessons as well as practicing the topics learnt through discussions and implementation within the collaborative environment. It seems that this kind of course has many advantages as well as several drawbacks that should be considered before adopting the mixed model.

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