HOW CAN WE EDUCATE STUDENTS ON THE WEB ENGINEERING DISCIPLINE VIA THE WEB? THE NTUA'S APPROACH.

Symeon Retalis, Paris Avgeriou, Manolis Skordalakis

National Technical University of Athens
Department of Electrical and Computer Engineering
Software Engineering Laboratory
Tel. ++301 7722487, Fax. ++301 7722519
E-mail. {retal, pavger, skordala}@softlab.ntua.gr

ABSTRACT

Over the last years the Web has been increasingly used as a platform for supporting the delivery of flexible and interactive hypermedia applications. However, it is admitted that the dominant approach is ad hoc development. Developers should be educated in the use of effective processes, process models, methods, tools and documentation guidelines. In few words, they should be trained on the Web Engineering discipline. The number of courses which deal with this discipline is augmenting. National Technical University of Athens (NTUA), Greece offers such a course with a main pedagogical aim to make students well aware of the advantages when following systematic hypermedia development approaches contrary to ad hoc practices. NTUA's approach was to use open learning methods based on a Web-based instructional system. NTUA team developed the instructional system in a systematic way having challenged itself that such way can lead to pedagogically effective instructional delivery and to learning material fo high quality. The evaluation results showed that the challenge was met. This paper presents the NTUA's instructional approach about the web engineering discipline and the qualitative evaluation results.

1. INTRODUCTION

The World Wide Web has long ceased being simply a distribution medium for multimedia, and has become a development and run-time environment for sophisticated applications. The current state of application development in the Web environment is characterized by anarchy and ad hoc methodologies. It lacks effective ways and techniques for ensuring the integrity and maintainability of the system [Murugesan 1999].

Web Engineering (WebE) is concerned with the establishment and use of sound scientific, engineering and management principles and disciplined and systematic approaches to the successful development, deployment and maintenance of high quality Web-based systems and applications [WebE 2000].

The WebE discipline is very young and has started gaining attention of researchers, developers, and other major players in web-based application development market. One of their main concerns is the quality education and training on WebE. Moreover, there is an increasing need for continuous training in the WebE discipline.

However, there are very few educational initiatives in this field worldwide at the higher educational sector. Some of them are:

- Software Engineering for Web Applications, at MIT, part of Teaching by Philip Greenspun [http://www.photo.net/teaching/one-term-web.html]
- Web-application design and development, University of California [http://amber.berkeley.edu]

Moreover, very few handbooks exist as well as few workshops have been organised.

The Department of Electrical and Computer Engineering at National Technical University of Athens decided to tackle the didactic need on the WebE subject matter area by offering to its postgraduate students one semester course called "Internet Publishing" since 1998. It will be now renamed to 'WebEngineering" at the autumn semester 2000. Its aim is to offer technical knowledge, i.e. to enhance students Internet programming skills, as well as theoretical knowledge on the design and development of web-based applications. In fact, the main emphasis has been put on persuading students change the way of thinking when creating a hypermedia application and follow a suitable methodology.

An enriched classroom model based on the WWW has been developed for the instructional delivery [http://webct.softlab.ntua.gr]. The term “enriched” signifies that the open learning methods have been used complementary to the traditional ones. Apart from few ex-cathedra lectures, on-line learning material, learning activities and tools had been developed and integrated into the WebCT [www.webct.com] learning environment. So the students are provided with a variety of teaching aids for acquiring knowledge and skills without constraints in time and place of instructional delivery.

In this paper we present the philosophy and structure of the web-based course on WebE discipline, its delivery method as well as the positive results extracted after an evaluation study. The structure of the paper is as follows: In section 2 we describe the philosophy of the course while section 3 deals with the evaluation of the course delivery.

2. PHILOSOPHY OF THE COURSE

The course on WebE is a postgraduate course with one semester duration, starting on October and ending on February.
After the successful completion of this course, the students are better able:

- To follow structured and disciplined approaches in terms of engineering methodologies for hypermedia development

- To state practical web publishing problems and give examples of well designed web sites
- To construct interactive Web sites

Open learning delivery vehicles supplementary to the traditional ex-cathedra methods have been used within this course. The students attended few lectures on topics such as:

- Introduction to web pushing and programming techniques
- Hypermedia design and development methodologies
- Web-based courseware development methodologies

The students also attended presentations by invited researchers and managers that work in the WebE field. The topics of the presentations were ergonomics on Internet, security issues, asynchronous multimedia conferencing systems, as well as special applications such as one for the Greek stock market, for a digital library and others.

The WWW was used to "add value" to the instructional process as well as to provide a flexible, stimulating and effective learning environment. The WebCT learning environment [http://www.webct.com] is the specific technological infrastructure on which the on-line learning material as well as learning tools have been integrated.

The on-line learning material consists of:

- Course description and study guide
- An electronic book about programming for the Web (covering the HTML v.4.0, Javascript, CGIs & Perl, and topics on setting up web servers). The book contains theory, examples as well as self-assessment exercises.
- Sample of an exam paper and its solution
- On-line library with links to resources such as:
  - Relevant handbooks like "Introduction to Instructional System Design" [http://www.nwlink.com/~donclark/hrd/sat.html] by Donald Clark
  - Papers about development methodologies for web-based applications such as the OOHDM [Scwabe & Rossi 1995], RMM [Isakowitz 1995], and CADMOS [Retalis & Skordalakis 2000].
  - Topics of discussion about the styles of web design with references to on-line Style Guides.

The suggested handbook for the course (though not obligatory) was the excellent book of [Lowe & Hall 1999].

Project-based learning was the main pedagogical method for this course. The students formed small groups in order to construct web-based applications following specific methodologies. There was a variety of applications proposed to the students as subjects for their projects, such as the development of web sites for a laboratory, company, etc. or e-commerce sites or web-based instructional systems.

The students followed development methodologies which required the submission of intermediate deliverables and documentation. Students submitted them in terms of on-line publication using the appropriate mechanisms of the learning environment, on specific deadlines and following

specific templates. Project deliverables concerned the documentation of the development process, such as requirements specification and design. Thus, all project groups could see the progress of the development process of their colleagues and act as peer-reviewers when asked by the instructor. Moreover, the on-line submission procedure augmented the collaboration among groups.

Face to face and asynchronous communication among tutors and students happened during the course. The tutors were available at specific office hours in order to help and advice students. Personal and group e-mail was the medium for further communication among students and tutors. Announcements and information about the course were posted on the web-based learning environment.

3. EVALUATION STUDY

It was a real challenge to use the WWW as development platform and instruction delivery vehicle for a course which deals with WebE. We had to provide a high quality web-course so as to achieve learning effectiveness and to convince the learning audience that the web-based application development methodology, which we followed when constructing the course, is effective.

Subjects

The drop out rate was 19,6%, i.e. 10 students out of the 51 registered did not finish the course. 22 students (45% women and 55% men) out of the 41 who successfully completed the course, responded to the evaluation study. The study was based upon a post-test questionnaire which the students, i.e. the subjects of the study, were asked to answer after the completion of the course. The focus of the study was to assess on the quality of the on-line material, the enriched classroom delivery mode, and the instructional support provided during the course.

The majority of the subjects had previous experience in using computers but none of them had ever used ICT for learning. Seven (7) students had already experience with. In terms of the time spent accessing the web-based environment, the majority of the students spent approximately 1-2 hours per week. An average of 5 group e-mails was exchanged per week, delivering information about the course process, instructions and additional help about the development of the student projects. Quite a lot of personal e-mail had been exchanged between the tutors and the students for providing help to students in person, for arranging face to face meetings, etc.

Evaluation Results

The analysis of the qualitative data showed that students found the WebE course quite successful. All the students gave compliments about the quality of the course material as well as the enriched instructional delivery mode. This mode of instruction and learning provides great flexibility for meeting specific educational needs and a variety of learning styles. The WebCT learning environment was commented to be particularly easy and intuitive to use, as it

allowed a learning process through which the students could work at their own pace, time and place.

Interactivity was an important factor of quality stressed by the subjects. Students rated highly the need for the integration of computer-mediated collaborative learning into the course delivery, apart from simple e-mail exchange.

Concerning the prospective changes-additions to the on-line material as proposed by the students, more elaborated case studies on the hypermedia development methodologies will be constructed. The students need guidance for applying such methodologies to their projects and relevant case studies will be very helpful to them. The best project deliverables that some groups submitted will be used as case studies apart from new ones that will be developed from scratch.

Concluding we believe that we succeeded in offering a high quality course which was appropriate for the student body for which it was intended. The flexible and open learning mode was the most suitable for NTUA's postgraduate students who have job obligations aside their research duties. The upgrade of the course material and its delivery mode will happen during summer so that the students who will enroll in September 2000 will find it challenging and pedagogically effective.

4. BIBLIOGRAPHY

Murugesan, S. (1999). *ACM SIGWEB Newletter, Vol. 3 (3),* October 1999.

WebE (2000). *Web Engineering Home Page*
[http://fist.mararthur.uws.edu.au/san/WebEhome]

Isakowitz, E. Stohr, A. & Balasubramanian, P. (1995). RMM: A Methodology for Structured Hypermedia Design, *Communications of the ACM, Vol. 35 (8),* August 1995.

Lowe, D. & Hall, W. (1999). *Hypermedia & the Web: An Engineering Approach*, John Wiley & Sons Ltd.

Retalis, S. & Skordalakis, E. (2000). An Approach for Solving Instructional Problems Using Networked Technologies, *Computers in Human Behavior*, (to appear).

Scwhabe, D. and Rossi, G. (1995). The Object-Oriented Hypermedia Design Model (OOHDM), *Communications of the ACM, Vol. 35 (8),* August 1995.