Building an Internet-Based Learning Environment in Higher Education: Learner Informing Systems and the Life Cycle Approach

Zeynep Onay

Middle East Technical University, Turkey

onay@man.metu.edu.tr

Abstract

The last years of the millenium have witnessed an exponential growth in courses, degree and certificate programs offered on the Internet. Many universities have felt the pressure and responded to the challenge of new technologies. Middle East Technical University (METU) is the first university in Turkey to initiate Internet-based learning through its METU-Online project. METU has taken a centralized approach for the establishment of METU-Online in order to avoid duplication of effort and enable the consolidation of scarce resources; all activities pertaining to Internet-based learning are coordinated by the Informatics Institute. This paper uses the Informing Science Framework to present the institutional system established at METU, and describes the activities involved in implementing METU-Online in relation to the phases of the systems development life cycle. It then introduces the main features of METU-Online and provides an appraisal of its impact. The Informing Science Framework defines the components of Internet-based learning. The life cycle approach shows the phases involved in building learner informing systems and the activities that need to be carried out at each phase. The Informing Science Framework and the life cycle approach together constitute a template that may be used by other universities embarking on such a mission.

Keywords: Internet-based learning, Informing Science Framework, Life Cycle Approach

Introduction

The power of communication and information technologies presents universities with new opportunities to strengthen the quality and productivity of education. In a global knowledge-based economy, with an ever-growing demand for learning, the Internet is seen as a vehicle for promoting effectiveness in teaching and for reaching wider audiences. Numerous courses, degree and certificate programs are being offered on the Internet. It is now possible to reach 3700 courses offered by 100 accredited institutions from one site alone (New Promise, 1998). Virtual universities like Athena, California Coast University, Jones International University, California Virtual University, Western Governors University are a reality today.

Traditional universities are now facing competition from a new "education industry". A number of profit and not-for-profit organizations have emerged as providers of education in this technology-mediated environment (Ives & Jarvenpaa, 1996; Marchese, 1998). Corporate universities like AT&T and Motorola are growing in number, size and scope in the continuous education market (International Association for Management Education, 1996; National Committee of Inquiry into Higher Education, 1997).

Thus, the very structure of higher education is changing. Universities recognize the need to redefine their strategies for the 21st century (Association of European Universities, 1996; Pelton, 1997). New partnerships between universities and alliances between universities and companies in telecommunications and publishing are being formed to leverage the power of new systems and technologies (Hanna, 1998; Marchese, 1998; International Association for Management Education, 1998b). Established higher education institutions are setting up their "virtual" campuses. Washington State's Web University, Pennsylvania State's World Campus, the University of Wisconsin, California State University, Michigan State University, the University of California-Berkeley are only some examples of the response to the challenge of new technologies in higher

education (Hanna, 1998; International Association for Management Education, 1998a).

Middle East Technical University (METU) is the first university among the 71 universities in Turkey to implement an Internet-based learning environment: METU-Online. One of the leading universities in Turkey, METU has over 20,000 students enrolled in graduate and undergraduate programs offered by 39 departments in five faculties. The planning, development and implementation of METU-Online has been carried out by the Informatics Institute. The Institute is an interdisciplinary graduate school, offering three degree programs: Information Systems, Cognitive Science, and Modeling and Simulation.

The METU-Online project started in May 1998. The first implementation of online courses took place in fall 1998. Within one academic year, a total of 15 graduate and undergraduate online courses have been offered to almost 2000 students. In addition, the Introduction to Information Technologies and Applications course, designed by the Informatics Institute and aimed at propagating basic computer literacy skills to all METU students, has been delivered to a further 2000 students at the English Preparatory School at METU. Starting in fall 1999-2000, this compulsory, non-credit course will be offered through METU-Online to all departments within the University. In February 1999, the Informatics Institute also launched the Informatics Certificate Program. The certificate program is aimed at training instructors from other Turkish universities who will be in charge of designing and delivering introductory computer literacy courses in their own universities. The program consists of 6 courses (40 hours each) and its duration is 8 months. Currently, 50 participants from various universities in Turkey are enrolled in the program delivered asynchronously on the Internet.

Internet-based learning represents a new paradigm involving the interaction of several fields. This paper defines the components of this paradigm in terms of the Informing Science Framework, and uses the phases of the systems development life cycle to describe the activities carried out for the establishment of METU-Online. The main features of the system are presented and emergent factors bearing on the effectiveness of online courses are proposed.

New Paradigm in Higher Education and the Informing Science Framework

Delivering courses on the Internet involves much more than a change of medium from face-to-face classroom interaction to an asynchronous environment. The Internet largely removes the time and place constraints of classroom education. This departure from the traditional "lecture hour" and "classroom" concepts represents a fundamental paradigm shift in higher education. The change is one that deeply affects the university as an institution, the instructor and the student as individuals. For the university, the adoption of new technologies requires a restatement of institutional missions and priorities. For the instructor and student, Internet-based courses represent a shift in educational philosophy and instructional design because the emphasis is in on "learning" instead of "teaching", thus implying a move to a student-centered, rather than instructor-based system, where interactivity and collaboration are key determinants of success.

At the center of this paradigm is the establishment of an information system that will enhance the students' learning experience. The development and implementation of such a system necessitates the aggregation of several areas of knowledge; behavioral, technological and managerial aspects must be synchronized to achieve an effective "learner informing system" (Cohen, 1998). The core elements of this system can be conceptualized in terms of Cohen's Informing Science Framework. The framework consists of three components that mutually affect each other: the informing environment, the delivery system and the task-completion system (Figure 1).

The Informing Environment is the component that creates information for the learner. The Informing Science Framework defines the Informing Environment at three levels. At the first level an existing system is being used. The second level pertains to the creation of additional instances for informing, while at the third level a totally new system is designed. In terms of learner informing systems, the first level represents the classroom with face-to-face contact in teaching; at the second level the Internet is used as a supplement to classroom teaching; the third level consists of the creation of a fully asynchronous learning environment for the new paradigm in education.

The Delivery System is the vehicle for realizing the informing environment**.** It is the means for providing information. In an asynchronous learning environment, the Internet and multimedia technologies, used with various degrees of face-to-face contact with learners, constitute the Delivery System.

The Task Completion System refers to the environment in which information is used. Here the client to be informed is the learner. The task to be accomplished is effective learning.

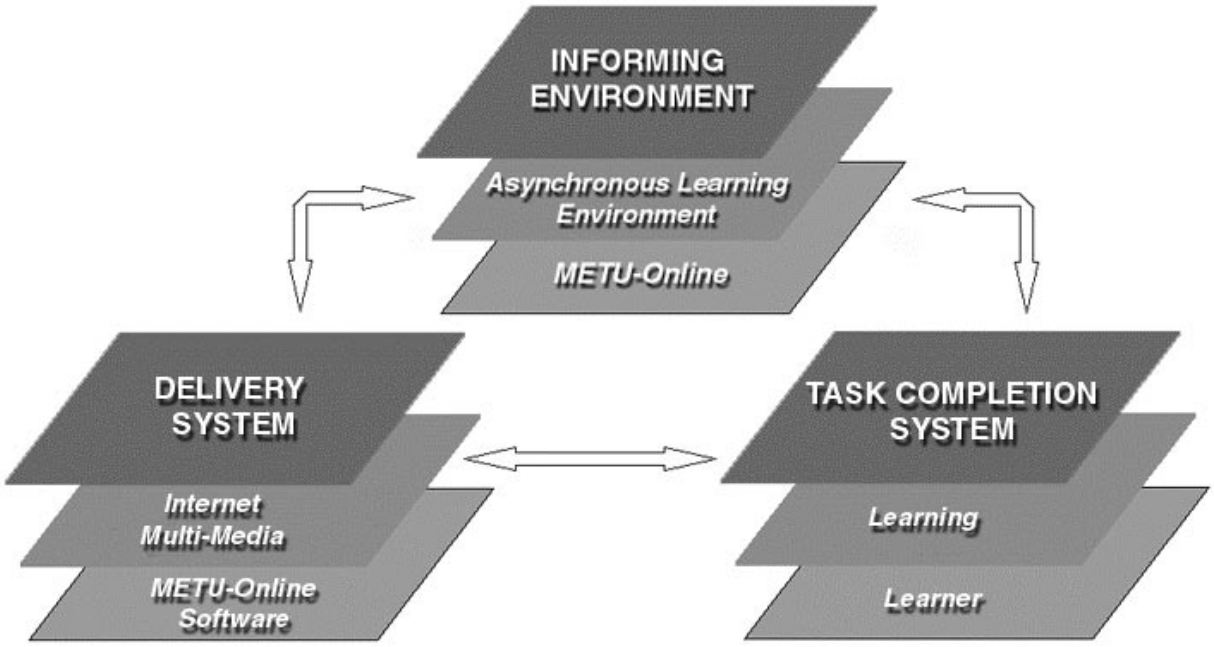

Figure 1: Learning Informing Systems

The Informing Science Framework shows the rational behind the interdisciplinary approach adopted by Middle East Technical University for the establishment of its Internet-based learning environment. At the Informatics Institute a team of faculty from the departments of management, computer engineering, electrical and electronic engineering and education is responsible for the METU-Online project. The courses offered on METU-Online come from the graduate and undergraduate curricula of various departments within the University, ranging from history to astronomy. All online courses share the same resources for preparation and delivery in the Informing Environment which is METU-Online, and they are provided through a common Delivery System. The Task Completion System covers on-campus as well as off-campus learners from a variety of disciplines.

The Life Cycle Approach for Building an Internet-Based Learner Informing System

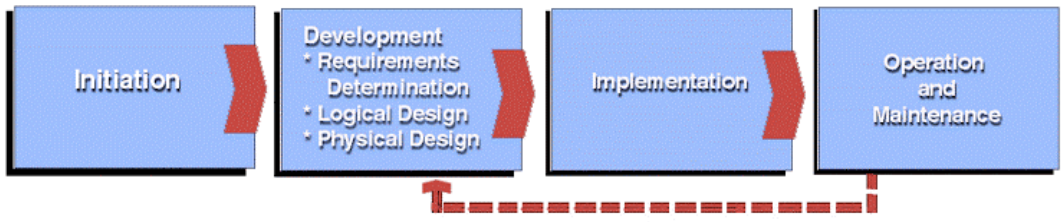

Figure 2: System development life cycle

The process of building an information system consists of four distinct phases: initiation, development, implementation, operation and maintenance (Alter, 1996). These phases constitute the system's life cycle (Figure 2). The life cycle approach has been used to create the Internet-based learner informing system at METU. The activities covering administrative, instructional design as well as technical aspects pertaining to each phase of the life cycle are described in this section.

Initiation

Based on the strategic plan of the University, the initiation phase served to determine the scope and feasibility of Internet-based instruction at METU. During this phase, asynchronous learning implementations at other universities were investigated. The scope of the METU-Online project included the determination of essential factors that will enhance the quality of learning, the development of the METU-Online software, and the coordination of the preparation and delivery of courses. The characteristics of the University as an institution, and the instructors and students as users were examined to derive operational feasibility. The hardware and software infrastructure on-campus was reviewed to establish technical feasibility. A preliminary budget for the project was derived to test economic feasibility.

The initiation phase resulted in the derivation of a project plan and the formation of a project team at the Informatics Institute. In addition, a core group of graphics designers and programmers was established for the development of the METU-Online software.

Development

The development stage consists of the determination of requirements, the logical design of the system and physical design. Each of these phases is described below.

Requirements determination

The requirements determination phase covered a detailed investigation of existing university rules, regulations and administrative procedures in order to establish their compatibility with Internet-based instruction. The curricula of all departments were also examined, in order to establish priorities among the courses to be offered online.

At the same time, a thorough analysis of the types of software used for course preparation and delivery was carried out. This phase also covered instructional design features that are central to online courses.

This analysis stage led to the specification of requirements for setting up an Internet-based learning environment and the establishment of priorities for resource allocation and target student populations.

Logical design

Based on the requirements derived during the previous phase, this stage entailed the design of:

- criteria for course selection,
- standards for course preparation,
- new administrative procedures,
- proposals for an instructor incentive scheme,
- recommendations on copyright issues,
- support processes for instructors and learners,
- and the features of the software tool as an element of the delivery system.

Course selection criteria refer to the parameters used to determine the priorities among the courses to be developed online. These include the number of students enrolled in the course, the type of course (compulsory or elective), its frequency, faculty ability to develop the course online and the suitability of the department's infrastructure (e.g. the availability of student computer laboratories) for delivery.

The standards to be followed during course preparation pertain to details about the format, layout, visual and navigation features of the course Web pages. These were designed as essential guidelines for instructors preparing online courses.

New administrative procedures were developed regarding the proposal, acceptance and accreditation of online courses. Accordingly, an online course is proposed to the Informatics Institute by a faculty member from any department within the University. The courses to be developed online are determined based on the course selection criteria mentioned above. The Institute ensures funding and technical help for preparing the online course. Once the course is ready, it goes through an accreditation procedure. Accreditation is in two stages. Before the course is delivered online, it is reviewed in terms of content, instructional design and observance of course preparation standards. Following this preliminary accreditation, the related department approves the online delivery of the course. Full accreditation takes place after the course has been delivered on METU-Online for at least one semester. This enables the assessment of learning outcomes and incorporation of additional features to enhance effectiveness.

Formal administrative procedures were also designed for the online application, admission and registration of non-METU

students. Prior to this, all non-METU students had to be physically present in order to enroll to courses.

The design of support processes included the assignment of responsibilities for infrastructure upgrade and maintenance, as well as technical support for instructors and students.

Physical design

The last phase of development involved the approval of all new administrative procedures and the establishment of an Accreditation Committee by the University Senate. This phase also covered the preparation of online courses by individual instructors and the development of the software tool for METU-Online.

Implementation

The implementation phase consists of the preliminary accreditation of online courses, system testing, and conversion. The conversion process establishes the delivery mode for each online course. Analogous to information systems conversion methods, four modes are valid in METU-Online: direct cutover, parallel, phased and pilot.

In the direct cutover mode the course is conducted fully on the Internet, with no face-to-face contact. In the parallel mode, classroom instruction is complemented with online material. Phased conversion implies that regular class meetings are held each week but with reduced contact hours, the remaining credits being taken online. In the pilot mode, the course is offered online to a group of students only, while the rest of the class follows traditional classroom instruction. For each course, the delivery mode is decided by the instructor and the related department.

Operation and maintenance

The system's administration is carried out by the Informatics Institute. It includes the assignment of user accounts and passwords, provision of class rosters for each course, technical support to instructors, and the maintenance and update the METU-Online Web site.

This phase also entails a post-implementation review of the METU-Online system and online courses by students and faculty.

Currently a number of enhancements to the system are being developed. These include the creation of an authoring tool to facilitate course preparation and reduce instructor dependence on technical staff; improvements on the forum (chat board) for better administration of threaded discussions by the instructor; the creation of a frequently-asked-questions database for each course; the incorporation of intelligent agents to guide the students' learning experience.

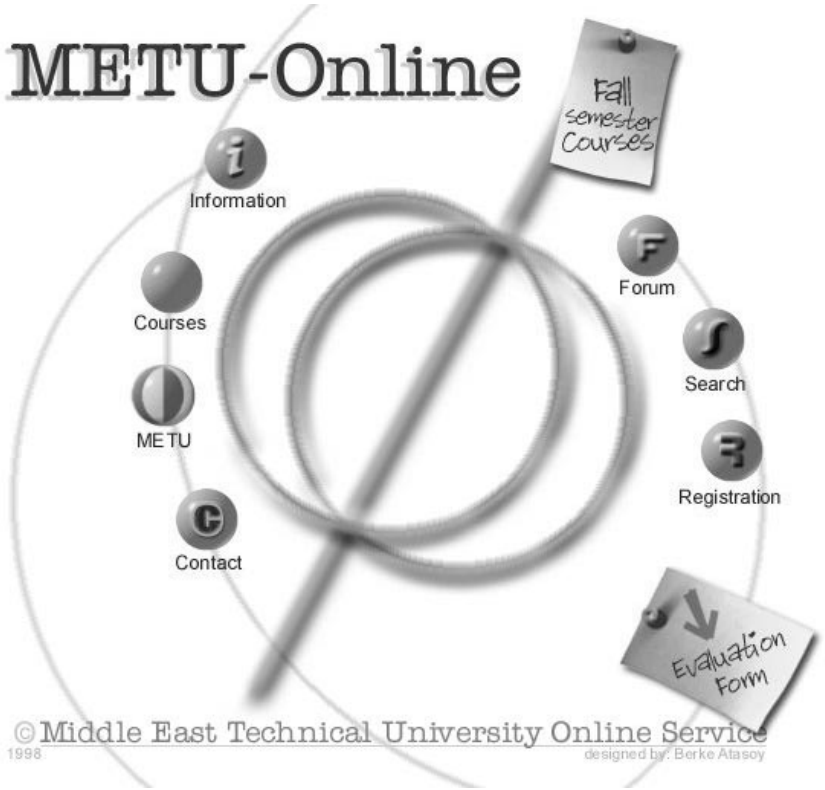

Figure 3: METU-Online home page

Features of METU-Online

A primary consideration in the design of METU-Online has been the inclusion of features that add value to student learning and enable instructors to achieve instructional effectiveness. The aim is to promote active learning.

The METU-Online home page (Middle East Technical University, 1999a) has an attractive and user-friendly graphical interface (Figure 3). Students can enroll to courses directly from this site by using the "Registration" button. A demonstration version of all the courses offered can be reached from this main screen. This enables students to review the detailed course schedule, course outline, grading policy and sample lecture notes before applying to the course. The site also contains a forum through which views and queries can be posted. The "Search" button enables keyword searches by course or for all METU-Online categories.

The graphical design and function of buttons on the main page of each course are identical. This standard interface is a structured template that prevents user confusion, especially for students who take more than one METU-Online course. It also ensures that all courses have the necessary features set by the Accreditation Committee. Figure 4 shows the main page of the Management Information Systems course developed by the author (Middle East Technical University, 1999b).

The syllabus page contains information on the course outline and format, mode of delivery and grading policy. It provides the students with a clear statement of what is expected from them in an online course, as well as guidelines on how to use the site for best results. A detailed schedule indicates the topics to be covered each week and the related assignments. There are links to lecture notes and assignments from the schedule. The schedule is an essential guide for students to plan their studies.

The lecture notes are structured by topic, consisting of a series of Web pages, broken down into sub-groups to keep students interested and focused. Learning objectives are clearly stated at the beginning of each topic. The notes include links to related sites, pop-up windows with real life examples, and challenging questions that allow students to self-check if they have reached the learning objectives.

The forum and announcements pages are two essential attrib-

Figure 4: Course main page

utes of online courses. They are central for sustaining communication among students and between the instructor and students. Threaded discussions on the forum encourage participation and collaboration. The announcements page allows the instructor to steer the course dynamically and announce any changes or additions to previously established dates, topics or activities.

The "Instructor" button is restricted to the use of the instructor. Although students see this button, the instructor's password is required to activate it. This button features a test generator, a gradebook and automatic grader, as well as a student log monitoring facility. The "Student" button allows students to take online examinations and tests, which consist of multiple choice or fill-in the blanks type of questions prepared by the instructor using the "Instructor" button. These are automatically graded by the system and students can access their grades from this page by supplying their individual passwords.

Students and instructors evaluate the METU-Online system and courses through online questionnaires at the end of term. Results indicate student motivation is high. This is especially true for courses incorporating "virtual laboratories" which are very effective in courses like astronomy, physics or image processing. In courses where some degree of classroom contact is maintained, instructors also observed higher attendance to class meetings by students, compared to previous years when the same course was delivered in the traditional way. In terms of grades, the class average is at least equal and often better than the average grades for the same course delivered in the classroom environment. However data on several more semesters are needed to derive statistically meaningful evidence on the performance of online courses.

Debate

Internet-based courses pose several challenges. For the university, the main challenge is to overcome resistance to change. The hierarchical organization in most universities is slow to respond and adapt to this new paradigm (Cohen, 1998; Pelton, 1997).

For the instructor, the challenge is one that fundamentally alters his/her role (Andriole, 1997). The instructor must become a "moderator" in the students' learning experience as the focus shifts from "teaching" to "learning". The instructor has to develop meaningful learning activities, and more importantly, cater for the individual learning styles of students in an Internet environment. A fundamental issue is to maintain the communication and interaction among students, between the students and the instructor, and the student to other resources like books and online reference materials (Sherron & Boettcher, 1997).

On the part of the student, s/he is no longer a recipient that absorbs the information delivered. The student must change from being a passive listener to becoming an active participant in the Task Completion System. Students are empowered to enhance their learning process in an asynchronous environment with little or no face-to-face classroom contact. This requires maturity, self-discipline and motivation. Students need to learn how to learn (Tan & Chan, 1997).

These challenges and the evaluation results of METU-Online suggest that the effectiveness of online courses depends on a number of factors:

- Degree of "prepackaging" in the course: it can be said that the less structured a course is, the more it can be customized to individual learning needs. This to a large extent relies on the ability and willingness of the instructor.
- Size of the class: METU-Online experience suggests that online courses are more effective for large classes (over 100 students), because individual interaction with the instructor and communication among students can be established to an extent that is rarely possible in a traditional classroom.
- Mode of delivery: when full contact hours are maintained as in the parallel mode of conversion, the usefulness of the system diminishes in proportion to the extent of formal lecturing during class. Class contact should be used for discussion of assignments, case studies and seminars by invited speakers, rather than teaching the material already available online.
- Degree of "homogeneity" among students taking the course: students who have been sharing the same environment (e.g. 4th year undergraduates of the same department) have a common understanding and culture, and therefore tend to participate and collaborate more than students who come from different backgrounds (as in a typical MBA class), and who have shared the learning environment for a much shorter period of time.

No single factor is dominant. Rather a combination of these four factors is likely to affect outcome. Further research in this area could point to the determination of patterns that are most effective for learner informing systems.

Conclusion

METU has taken an institutional approach to the initiation of Internet-based learning in order to avoid the proliferation of different methods and the duplication of effort. The planning, funding, development and delivery of courses are centralised at the Informatics Institute. This allows the consolidation of scarce resources and facilitates the resolution of common behavioural, technical, and managerial issues.

The Internet-based environment established in METU is a step towards breaking down the traditional barriers between disciplines: the development of METU-Online has shown that establishing a learner informing system requires interdisciplinary collaboration; the virtual environment created through the implementation of the system has further eroded hierarchical structures.

The initial results are promising, but it is still too early to claim conclusive evidence about the impact of Internet-based learning on effectiveness and productivity in higher education. The degree of prepackaging in the course, the size of the class, the mode of delivery, and the degree of homogeneity among students taking the course are suggested as factors affecting success in this new informing environment. The Informing Science Framework and life cycle approach constitute a useful template for research in this area. Further, they provide a blueprint for developing learner informing systems.

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