Guidelines for instructors on Web-based construction education

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ABSTRACT: Despite ongoing advances in the World Wide Web (WWW) and multimedia technologies in education, many educators are still sceptical that it can meet the educational needs of an increasingly diverse student population given the limited resources of instructors, administrators and physical classrooms. This article presents the development of guidelines for an instructor on how to incorporate Web technology in advancing construction education. This guideline was the result of an extensive literature review and the authors' experience in implementing Web technology into three main engineering courses that are different in their nature of delivery and presentation. These courses were: Construction Contracts (non-graphically oriented), Construction Methods (graphically oriented) and Engineering Statics (mathematically oriented).

INTRODUCTION

The increase in World Wide Web (WWW) based educational environments has provided new opportunities for interactions with the course material, the instructor and students. These new opportunities are becoming alternatives and/or supplemental models to the traditional educational models currently in use. The advances in WWW technology in education range from a static worldwide electronic library of information to different dynamic interactive media for educators and learners around the world. These tools host teaching and learning materials for both the teachers and students when used for Web-based courses. They provide facilities to improve not only accessibility, but also interactivity within the classes.

This article discusses the advantages and disadvantages of using Web-based courses in engineering education. It presents issues related to the use of multimedia and WWW techniques in online and offline courses. Most of these issues are a result of a thorough literature review and the authors' own experiences in developing and incorporating such technologies in their courses.

The article also describes a simple guideline for designing and developing Web-based courses starting from the identification of technology requirements to course selection to implementation and evaluation.

GENERAL BACKGROUND

The Web provides students with opportunities for self-directed, activity-oriented and task-engaging work, which allows students to construct their own meaning from the work undertaken [1]. The hypertextual organisation allows materials at different levels of detail or difficulty to be made available to students without imposing a pre-determined path for them to follow [2]. The hypermedia environment structure, the Web and learner's cognitive models, has been noted for its similarity to the models of how people acquire, store and retrieve information, knowledge and concepts [3][4]. The acceptability of this notion is based upon the acceptability of the learning theory of the constructivist tradition, that is the individual's knowledge is constructed according to the learner's particular knowledge state [5][6].

The Web is effective in two main ways: instruction and reference [7]. Furthermore, the Web has many other capabilities that are useful in developing personal communication skills [8]. This is an important aspect in managing construction projects. All this is possible though the collaborative work that hypermedia systems promote [9-11].

Studies have shown that learners profit immeasurably from environments that encourage shared learning [2]. The Web was originally conceived for the purpose of collaborative research and continues to be useful in this regard [12]. The idea behind collaborative construction projects and assignments is to provide students with opportunities to develop their teamworking skills and abilities. Collaboration can be synchronous – in real time and immediate, such as by Internet Relay Chat (IRC) and videoconferencing. Collaboration can also be asynchronous, such as by e-mail, newsgroups, and WWW pages [13].

The use of the Web technology in education has its barriers, disadvantages and challenges that cannot be ignored. Some of the drawbacks of instructional hypermedia were identified by Yang and Moore, as well as McKenzie [9][14]. The factors include: students' lack of knowledge about the learning process, Web navigation ambiguity, cognitive overload and too much information. Not every student or teaching institution can

afford the price tag of this technology. According to Owston and Mike, development and maintenance of Internet-based material can be costly [15][16]. In addition, Web-based courses could become time-consuming compared to the face-to-face (F2F) instruction [17]. Legal and ethical issues are also of major concern to the implementation of the Web technology in education.

RESEARCH FOUNDATION

This research falls into the mainstream of utilising available Internet and multimedia technologies for the purpose of enhancing engineering education at Kuwait University, Safat, Kuwait. A methodological guideline was developed for civil engineering instructors on how to incorporate Web technology in advancing construction education.

At the Civil Engineering Department of Kuwait University, the first author of this article made the initial attempt to convert a civil engineering course, CE430 - Engineering Contracts (spring semester 1998), into a Web-based format. The course site included: course syllabus, class notes, homework assignments, quizzes, links related to topics discussed in class and a discussion room for students.

The on-the-Web course contents became supplemental to the course materials given in the classroom. The students had the convenience of downloading course materials and interacting with the professor from home and computer labs. In the spring semester of 1999, another structural engineering course, CE202 - Engineering Statics, was implemented using the Internet and multimedia technologies; this was part of a funded project by UNESCO.

These and other experimental efforts in converting engineering course materials into a Web-based format at the College of Engineering of Kuwait University formed the foundation for the proposed dynamic guidelines for the successful utilisation of Internet technology in construction education.

METHODOLOGY

Along each step of the methodology of this project, voluntary faculty members from the Civil Engineering Department have participated in brainstorming sessions to contribute to the design, development and evaluation of such Web courses. The dynamic guidelines for instructors are detailed below.

Identification of Existing Technical Capabilities

A procedure was set that would outline the information technology (hardware and software) capabilities available in the Civil Engineering Department for the purpose of fitting technological resources with the Web-based education information system's objectives. The technology is upgraded periodically with the newly released versions.

The software resources included end-user Web and graphics tools, such as Microsoft *FrontPage2000* and *PhotoShop7*, and application tools such as *Java* scripts and Microsoft *Excel* and *Access* database. Even though programming tools such as HTML and Microsoft's *Visual Basic* provide flexibility in the system design, they are avoided due to the low return compared the time needed to learn and implement such tools.

Organisation of the WWW Index

The structural organisation of the Civil Engineering Department was modelled and put in a diagram to be used as the outlook shell/index of the WWW system. The index provides links to all the different elements of the organisational structure of the Civil Engineering Department. Each element has its specific sub-links that vary in scope and structure depending on the nature of the element. The focus is on the two main elements: courses and the instructor's guide for Web-based education (see Figure 1).

Figure 1: View of the main index.

Selection of the Construction Courses

This research started with three main courses to be developed on the Web. These courses were:

- Engineering Statics - CE202 (basic engineering) (see Figure 2).
- Construction Contracts - CE430 (junior year/non-graphically oriented materials) (see Figure 3).
- Construction Technology - CE437 (senior year/graphically oriented materials) (see Figure 4).

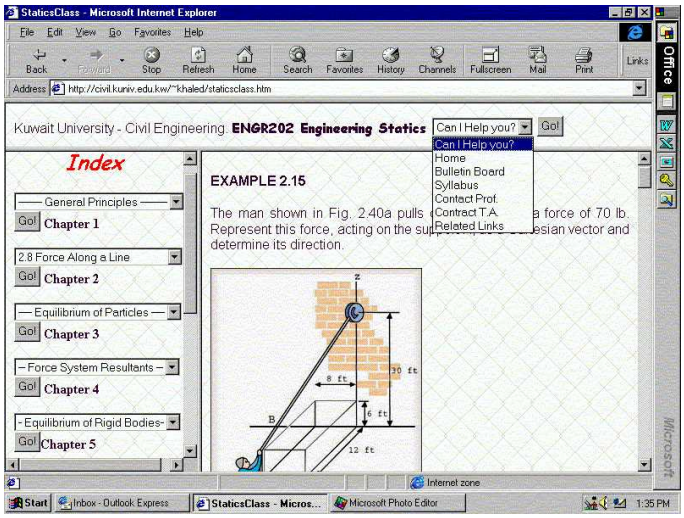

Figure 2: Example of the Web content for Engineering Statics - CE202.

A faculty member was assigned as a coordinator for each course; this was mainly for updating the course materials and

its structural elements based on the feedback obtained form the students and other faculty members.

Figure 3: Example of the Web content for Construction Contracts - CE430.

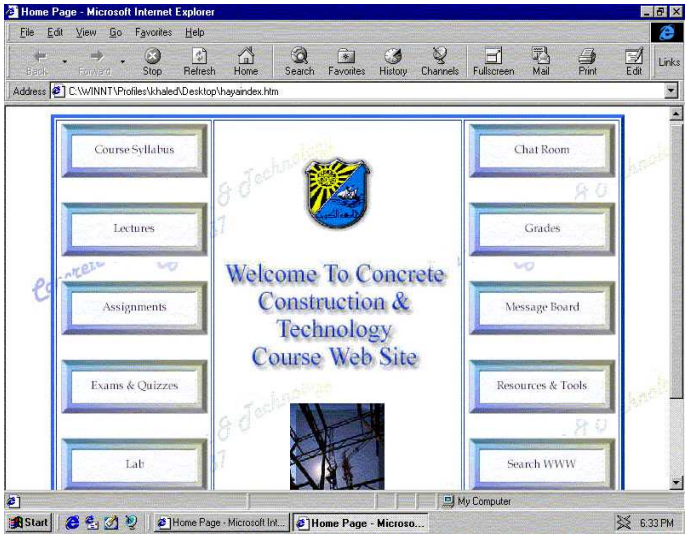

Figure 4: Example of the Web content for Construction Technology - CE437.

Technical Roadmap

A comprehensive guideline was developed as a roadmap for instructors interested in Web-based construction education (see Figure 5).

The guideline is dynamic in its outlook and takes into account the *know-how* and experience that instructors may develop along the process. The roadmap model was put in a breakdown structure for the purposes of modularity, scalability and ease of use.

The model also provides links to the most important sites that are related to the specific topic under consideration. In utilising this approach of hyper-linking to other sites, the model becomes more dynamic in its content and up-to-date with its topic references and tools. This approach avoids the time consuming process of *re-inventing the wheel* for developing education environments, such as courses that are already on the WWW.

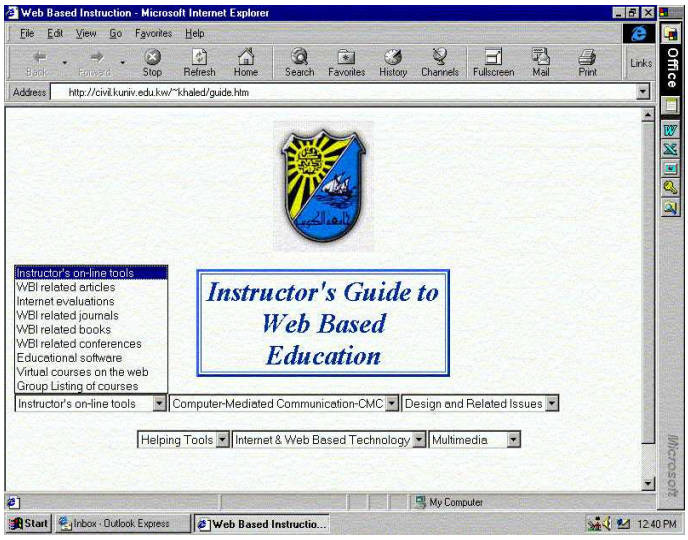

Figure 5: Comprehensive instructor's guide.

Construction of the Online Course

Using the technical roadmap, instructors can design, construct and create related links to their Web-courses according to the course needs and available technologies. The final product is then tested for technical functionality on the Web and its simplicity of use for students. Whenever the system failed to carry out any of its functions, it was taken back to the design stage for further technical reviews and modifications.

Implementation and Evaluation

The Web-based course is incorporated in the teaching process and is evaluated by both teachers and students. Learner performance will be assessed through quantitative indicators such as grade scores (eg exams, homework, projects) and time of student engagement with the Web-based course materials.

Qualitative assessment is carried out through a questionnaire on Web usage in the learning process, which is given to students and teachers at the end of the coursework. This qualitative assessment is also part of the evaluation of the learning environment to determine future improvements.

Quantitative and qualitative indicators of students in the study programme are then compared to similar indicators of students who did not take part in the programme. Conclusions and recommendations are drawn based on the completion of the evaluation process.

CONCLUSION

The Internet and telecommunications can enhance education in a wide range of areas, such as Web-based courses, educational administration, electronic publishing, resource information and references, professional networking and research and development. The range of areas of Internet applications in education is increasing and takes different and innovative forms due to the continuing advancements of multimedia tools.

A methodological guideline was developed for civil engineering instructors on how to incorporate Web technology in advancing construction education. A set of guidelines was based on the experimental work undertaken at the Civil

Engineering Department of Kuwait University. Almost all of the 37 faculty members of the civil engineering department expressed interest in utilising the proposed model for their courses.

Initial implementation is promising in enhancing construction education in the following fields:

- Defining areas of improvements to the Web-based civil engineering education.
- Developing a metaphor Web-based course for all the civil engineering classes in the Department.
- Encouraging acceptance of Web technologies in the academic environment.
- Improving teachers' abilities with regard to incorporating Web technology in the education process.
- Enhancing a collaborative environment in academia.
- Encouraging self-directed long-term learning and education.

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