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A dynamic system to manage changes in course material

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Abstract

Purpose – Despite the popularity of existing course management systems, they do not consider the management of course material changes, particularly courses that require more than one instructor. The main purpose of this study is to instantly communicate course material changes to all instructors teaching the same course and to communicate approved changes to students registered on the course.

Design/methodology/approach – The fundamental hypothesis tested was whether the developed system effectively communicates changes in a timely manner. The level of students' acceptance to this new system was also tested. A dynamic course material change-management system was developed using visual basic programming language and an Access database. The system was applied to a hypothetical case study and to a currently running undergraduate civil engineering course.

Findings – Results indicated that changes made to a course material were instantly communicated to all instructors teaching the same course. It also indicated that approved changes were instantly communicated to affected students. As a result, students were satisfied with the instant notifications they receive whenever a change takes place.

Research limitations/implications – The proposed system does not include a methodology for online tests, course grades, and course assessment. The system needs to be integrated with these important features. Developments pertaining to integrating the system with these features will be considered for future investigation.

Originality/value – The novel aspect of the developed system is the effective management of challenges made to course material and communicating these changes to instructors and students in a timely manner. The system can benefit any institution at different educational levels.

Keywords Course material change-management, Online learning, Course management, Programming languages, United Arab Emirates, Communication

Paper type Research paper

1. Introduction

In the past, the term e-learning referred to any method of learning that used electronic delivery methods. With the advent of the internet however, e-learning has evolved and the term is now most commonly used to refer to online courses or web-based learning (Monahan *et al.*, 2008). Web-based learning uses network technologies to create, foster, deliver, and facilitate learning, anytime and anywhere. Many understand web-based learning as the most recent evolution of distance learning – a learning situation where instructors and learners are separated by distance, time, or both (Liaw, 2008; Raab *et al.*, 2002). In essence, it is most commonly used to refer to managing and delivering learning content online where instructors and learners are anywhere. This broader understanding is adapted for use in the present study.

The use of innovative learning and instructional strategies would improve communication, collaboration and interaction between the learners and educators (Hinger, 2007; Kaminski, 2005; Latchem, 2002; Martín-Blas and Serrano-Fernández,

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2009; Saw *et al.*, 2008). The importance of communication and collaboration within web-based learning has been highlighted previously by Preece (2000) and Thurmond and Wambach (2004) amongst others, and as a result, online forums and discussion boards have become an invaluable resource. They allow students to communicate with their peers and tutors thus empowering them to socialize and learn together online. While web-based learning systems have improved with time, there are still some issues to be resolved before a realistic learning experience can be provided.

Various web-based learning systems have been developed for higher education. For example, Web Course Tools (WebCT), the Web Course Homepage System (WebCH), Blackboard Learning System, and the System for Multimedia Integrated Learning (Smile), are the latest waves of technology-based pedagogical tools. They provide web-based learning platforms that use the internet as a delivery mechanism to allow students from all over the world to access a number of learning tools such as discussion boards, chat rooms, course content management, etc. Many institutions of higher education adopt such web-based learning systems for their courses. For instance, WebCT has been used by 2100 institutions of higher education all over the world, including famous universities such as Stanford, UCLA, and so forth (Ngai *et al.*, 2007). However, there is a lack of empirical examination of the adoption of such web-based learning systems and its applicability for use in international institutions. In the United Arab Emirates, Blackboard Learning System or WebCT are being used in almost all institutions of higher education as a means for posting and managing course material online, even if distance learning is not offered by these institutions.

The benefits of web-based learning, at the learners level, have been discussed in the literature (Liaw, 2008; Bouhnik and Marcus, 2006; Liaw *et al.*, 2007; Raab *et al.*, 2002; Shotsberger, 2000). As reported by Liaw (2008), Bouhnik and Marcus (2006) stated that web-based learning has four main advantages:

(1) Freedom to decide when each online lesson will be learned.

(2) Lack of dependence on the time constraints of the lecturer.

(3) Freedom to express thoughts, and ask questions, without limitations.

(4) The accessibility to course's online materials at students' own election.

Capper (2001), on the other hand, listed the benefits of web-based learning online courses as:

(1) *Any time*. a participant can access the learning program at any time that is convenient.

(2) *Any place*. The participants do not have to meet.

(3) *Asynchronous interaction*. Interactions can be more succinct and discussion can stay more on-track.

(4) *Group collaboration*. Electronic messaging creates new opportunities for groups to work together by creating shared electronic conversations and discussions.

(5) *New educational approaches*. Many new options and learning strategies become economically feasible through online courses. Online courses also can provide unique opportunities for teachers and learners to share innovations in their own works with the immediate support of electronic groups.

Despite the perceived benefits of web-based learning mentioned above, research indicates that students are often dissatisfied with the web-based learning experience. Bouhnik and Marcus (2006) stated that students' web-based learning dissatisfaction was based the following disadvantages:

(1) Lack of a firm framework to encourage students to learn.

(2) A high level of self-discipline or self-direct is required.

(3) Absence of a learning atmosphere in web-based learning systems.

(4) The distance-learning format minimizes the level of contact, as well as the level of discussion, among students. In other words, e-learning lacks interpersonal and direct interaction among students and instructors. The learning process is less efficient. When compared to the face-to-face learning format, e-learning requires students to dedicate more time to learn the subject matter.

This paper presents the development of a dynamic system for managing changes in engineering courses in a university in the United Arab Emirates. The university is currently using "Blackboard" as the learning platform for course material delivery and management. The four disadvantages mentioned above for distance learning are not an issue since the university uses the "Blackboard" environment for face-to-face learning. The main problem with this environment is managing changes made to courses at the department, college, and university levels. Due to the high enrolment, these courses require many sections that are taught by different instructors during the same semester. Each of these courses should have the same material for all sections (i.e. same assignments, midterm exams, final exams, etc.). This research utilizes the concept of web-based learning for use in face-to-face lectures and uses visual basic programming language to develop the course change-management system. Although the problem of having several sections for the same course are more severe at the college and university levels, the system is developed using civil engineering courses due to their accessibility and availability to the researcher. The developments made provide instructors and students in the civil engineering department with an easy access to course material in a collaborative environment. It also allows instructors to add and modify course material and provides a mechanism for managing changes made to any course material and informing all parties needed to be informed by such changes in a timely manner. Interviews with several students and instructors were first conducted to get their feedback regarding the advantages and disadvantages of the current university's "Blackboard" system. The main components of the system were presented and the developments made to it were discussed in detail. Implementation issues are discussed and a case study is then presented to validate the developed system and demonstrate its capabilities and features.

2. Interviews

The university under investigation in the United Arab Emirates uses Blackboard as its main web-based learning system and mainly uses face-to-face lecturing for teaching. Concise interviews were conducted among 172 students and 58 instructors to get their feedback regarding the university's Blackboard system and ask them about its benefits and drawbacks. The majority indicated that the main advantages of the Blackboard learning system are:

(1) Course material is available and accessible anytime.
(2) Course material is available and accessible anywhere.
(3) Students do not have to attend classes.
(4) Instructors can post grades and students can see these grades online.
(5) Instructors can post announcements to students anytime and anywhere.
(6) Instructors can have online tests and quizzes which can be graded electronically.

On the other hand, almost all instructors and students agree that the main disadvantages of the system are:

(1) None of the above benefits is valid when the server is down or when the internet connectivity is unavailable.
(2) It takes time to upload and download large-size files.
(3) Students do not know when a course material is uploaded until they login to Blackboard.
(4) Students do not know when a change/update is made to a course material.
(5) Instructors, who teach the same course for different sections, do not know if another instructor has made a change/update for a course material.
(6) There is no record for the history of changes made to course material.

Also, several instructors indicated that electronic materials of all courses are stored in the university server and there is no storage at the department level. The Faculty of Engineering, for example, is currently seeking the full accreditation from the Accreditation Board for Engineering and Technology (ABET). Having one single repository of course material at the department level is very useful and can help the course assessment committee in each department to easily access course grades to perform qualitative and quantitative course assessment. It will also allow the program accreditation committee to view the necessary information needed to obtain ABET accreditation.

In view of the above interviews, existing web-based learning systems, despite their importance, still lack three important issues:

- tracking changes made to course material;
- informing instructors and students instantly when a new material is uploaded and when an existing material is changed; and
- managing changes and allowing instructors to view the history of all changes.

The proposed system was, therefore, designed to overcome these three drawbacks highlighted above. The main components and the developments of the proposed dynamic system are summarized in the following section.

3. Proposed dynamic system

As shown in Figure 1, the proposed dynamic system integrates a client/server environment for the management of course material with a set of collaboration tools. The visual basic programming language is used to develop the main components of the

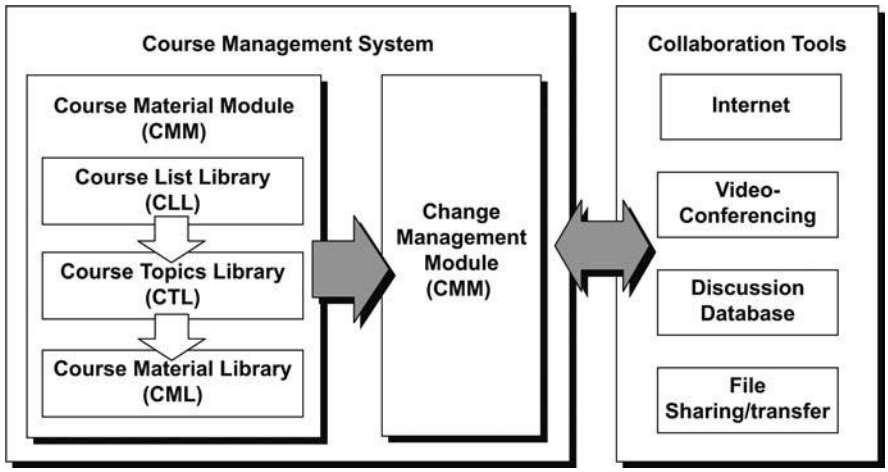

Figure 1.
Components of the proposed system

system, which is then integrated with commercial collaboration tools. The structured dynamic system is composed of two main modules: course material module; and change management module. Upon integrating the two modules, the developed system's main screen will appear as shown in Figure 2.

The proposed system can be used by instructors to upload, retrieve, and update course material, make new announcements, receive notifications about changes made to course material by other instructors in the same area of specialty, view changes history made to course material. Students, on the other hand, can view course material and announcements for courses they are registered in and receive notifications about changes made to course material by instructors. They will also automatically receive electronic messages informing them when a new material is uploaded or an existing material is changed/updated. In the following sections the components of the proposed system are explained in detail and a case study is presented for validation.

3.1 Client/server system

The proposed system is implemented on Microsoft Visual Basic 6.0 Enterprise Edition (Microsoft, 1998), which allows client/server developments. The choice of this programming language is due to its object-oriented programming features, relative ease of use, availability, and ability to integrate with other Microsoft family of software (e.g. Microsoft Excel, Access, and PowerPoint). The main components of the system are discussed in the following subsections.

3.1.1 System databases. At the core of the client/server system is a group of databases developed using Microsoft Office Access (Microsoft, 2003), which are directly readable by Visual Basic code. As mentioned in the introduction part of this study, the system is developed using civil engineering courses due to their accessibility and availability to the researcher. Civil Engineering courses in this institution are divided into eight main areas:

(1) Construction management.
(2) Environmental.
(3) Geotechnical.

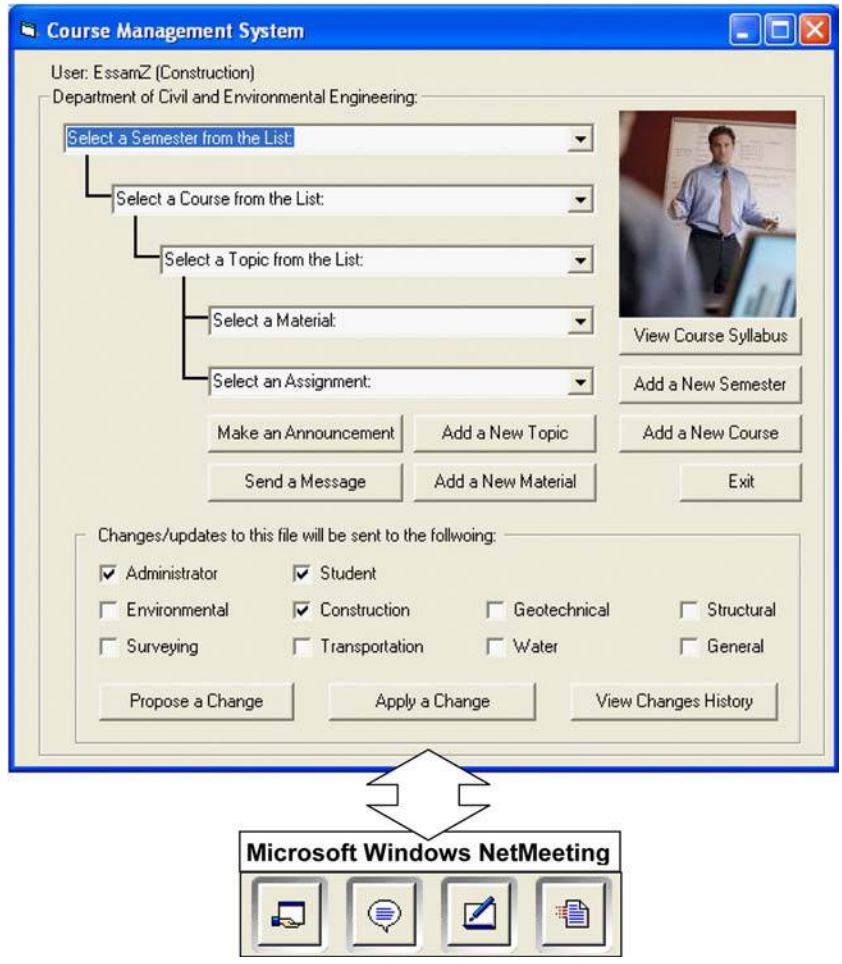

Figure 2.
Main screen of the proposed system

(4) Transportation.
(5) Structural.
(6) Surveying.
(7) Water resources.
(8) General.

One database is needed to store all the semesters of the years. Another database is used at the course level to store all civil engineering courses and generate a library of available courses in each of the eight areas (a separate table for each area). Since each course has its own course material, each course needs a separate database. Each course database is designed to contain six course-dependent tables for:

(1) Course topics.
(2) Course notes.
(3) Course assignments.
(4) Course exercises.
(5) Proposed changes to course material.
(6) Applied changes made to course material.

3.1.2 Course list library (CLL). The CLL is a central repository of all courses of the department of civil and environmental engineering at the university under consideration. This library is a dynamic one that can be updated periodically by instructors and monitored and maintained by the system administrator. All courses related to the eight civil engineering areas are stored in the "CLL database," which contains eight tables (one for each area). This database is accessible to all instructors and students. Instructors can view all courses or select to view course in their area of specialty only. For all civil engineering areas, 37 courses are stored in the CLL distributed in the eight tables. Each course has two main attributes; its syllabus and its topics. Each topic has its corresponding material and assignment(s). Only the system administrator has "add" access to the CLL, while all instructors and students have "read only" access. The system administrator can add a new course to the CLL and then specify the instructor(s) that can modify the material of that course. The system administrator can also specify route of changes (communication paths), which will help in communicating course material changes/updates to concerned parties. Once all this is done for a new course, the course is added to the CLL and then becomes ready for use. The information in the CLL, as such, is maintained with a high level of consistency and security.

3.1.3 Course topics library (CTL). The CTL is course specific, and allows for a unified storage and manipulation of course topics that promotes consistency and avoids redundancy. All course topics in the CTL are represented as smart objects that contain all their related information. As such, each topic in the CTL contains information related to its material related to the selected course topic. The instructor can add a new course topic by simply answering one question related to the new topic name. The system will then automatically generate a default assignment and four default components associated with the new topic (a lecture material and three exercises). To refine the initially generated components as per the detailed topic information, the instructor can change the default names of the components and can also add new components to the newly generated topic. All course topics are stored in the "CTL database," which is accessible to all instructors and students.

3.1.4 Course material library (CML). The CML is also course specific, and allows for a unified storage and manipulation of course material that promotes consistency and avoids redundancy. The CML includes information related to course lecture notes, assignments, and exercises. All course material in the CML are represented as smart objects that contain all their related information. As such, each material in the CML contains information related to parties that need to be informed in case a particular course material is changes, updated, or added. The instructor can add a new course material by simply answering two questions related to the material type, file type, and file name. The system will then automatically generate the material needed and add it

to the appropriate database. As mentioned in section 3.1.1, each course material is stored in a separate database that contains six course-dependent tables for:

(1) Course topics.
(2) Course notes.
(3) Course assignments.
(4) Course exercises.
(5) Proposed changes to course material.
(6) Applied changes made to course material.

Course databases are accessible to all instructors in the same area of specialty and to students registered in the course.

3.1.5 Change management module (CMM). It is important for students to know, in a timely fashion, when a new material is added to the course or when an already posted material is updated/changed. This is also important for instructors in the same area of specialty or those who teach different sections of the same course. One of the main features of the system is that each course material is an active object capable of automatically communicating changes made to them to interested parties. As shown in the bottom of the screen capture of Figure 2, changes made to the "construction" course material will be communicated to the system administrator, instructors in the same area of specialty, and students registered in the course. To facilitate course material change management, object-related procedures monitor new and old files of any course material, allow the administrator or instructors to propose changes to course material or add a new material and obtain approval from other parties before doing the change/add, and track/find changes made to any course material. The CMM also includes other general procedures (activated by the buttons shown at the bottom of Figure 2) that provide effective tracking of all changes made, allow interested parties to propose and respond to proposed changes, apply approved change-proposals, and obtain various reports on the changes made. These procedures keep course information up to date and allow the system administrator, students registered in the course, and interested instructors to see any new material or changes made to course material by instantly informing them with this change. Each course has a "changes" database that is composed of two tables used for storing changes made to the course (one for storing "proposed changes" and the other is for "applied changes"). Proposals for changes are temporarily stored in the "proposed changes" table and then transferred to the "applied changes" table at the instructor's request using the "apply a change" button shown in the bottom of Figure 2. If a proposed change is not approved and, therefore, not applied, it will stay in the "proposed changes" table. The reporting system queries the "changes" database to provide the user with useful information regarding pending changes and the history of changes made for any course during a semester. Sequential query language (SQL) statements are used to automatically query the databases and obtain the status of changes made by any party. Figure 3 shows how proposed changes and applied changes are communicated to different parties and the type of action that needs to be taken by each party when a proposed change or an applied change is made.

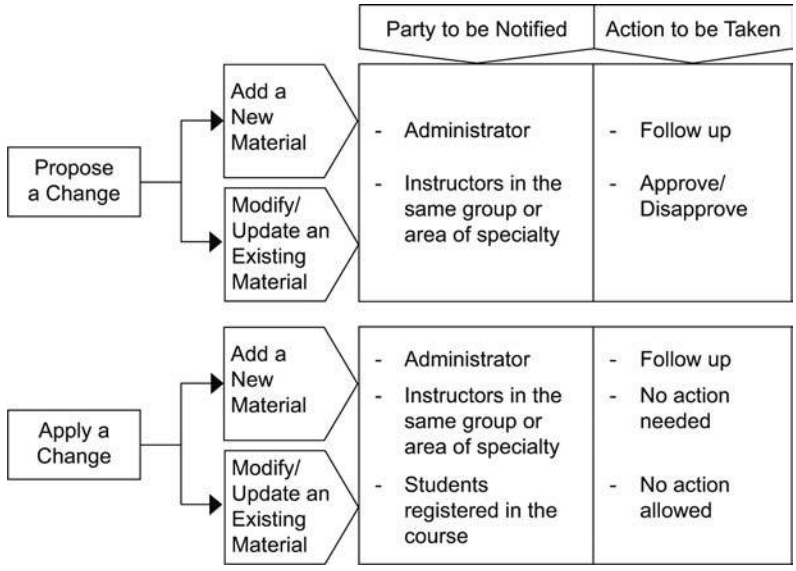

Figure 3.
Communicating proposed and applied changes

3.2 Collaboration tools

As shown in the bottom of Figure 2, the proposed dynamic system is linked with Microsoft Windows NetMeeting, Version 3.01 (Microsoft, 2001). NetMeeting is a standard Windows XP component. It is an internet-based collaboration tool that provides many features, such as video- and audio-conferencing, real-time whiteboard collaboration, real-time chatting, file sharing, and file transfer during a NetMeeting conference. Since the development of the proposed system is based on Microsoft's Visual Basic programming language, it can be readily integrated with other existing and new Microsoft products. The present system implementation has been carried out on microcomputers using Windows XP and Microsoft Office (Microsoft, 2003). For testing purposes, the computers were linked to the university's local area network (LAN). However, the system can be set up to be completely internet-based through the use of the web folders features of Office 2003, which permits files to be stored on web servers (rather than LAN servers). This further allows the user to take advantage of Internet collaboration tools, such as web discussions, web page postings, and the use of web browsers to view project documents directly.

While all of the collaboration tools presently used in the system belong to the Microsoft family of products, it is possible to take advantage of the latest developments and new advances in other collaboration tools (Seltzer, 1999) by adding them externally to the current system. HotOffice (2010), for example, is a collaboration tool that can integrate with Microsoft NetMeeting for document management and to provide a shared calendar for tracking meetings and tasks.

4. Implementation issues and solutions

The development and implementation of the collaborative system involved resolving several issues related to:

- establishing access control/access rights;
- saving and loading course material;
- enforcing change proposals; and
- applying and discarding changes and providing automated warnings.

Addressing these issues mandated a significant programming effort and iterative cycles of refinement to the model and substantial programming effort. The following discussion of the resolution of these issues provides useful guidelines to other researchers intend on developing similar complex systems.

4.1 Establishing access control/access rights

Password-based access control is used in the proposed system to identify the user's type and accordingly specify access rights to course material and its corresponding libraries. Instructors from each areas of specialty can modify their course material but only view the list of courses of all other areas of specialty. The administrator has "add" access to all courses and semesters in the system while instructors can only modify courses in their area of specialty only to add/update their course material. On the other hand, students registered in a particular course can only view this course material and receive notifications that changes to course material have taken place. All screens and change management options are customized to the different parties including the administrator, course instructors, and students. The reporting features, for example, provide instructors with a list of all changes made to courses material, as well as the changes they themselves made.

4.2 Saving and loading course material

Having a single course list database that is accessed by all parties causes the work of each area of specialty to be scattered in different places in the system. This creates a problem when attempting to save and load the work of each area of specialty. To resolve this problem, each course has a separate database that contains seven course-dependent tables. Each instructor can save to the databases related to the courses in his/her area of specialty and can not save to databases/tables of other courses. In this way, a unified representation of course material for all areas of specialty is securely maintained.

4.3 Enforcing change proposals

Using the proposed system, instructors from each area of specialty can change their course material at anytime. In some cases, however, it may be necessary to apply the changes made only after consultation and approval from all other parties in the same area of specialty. To allow this flexibility, the system permits the administrator to either enforce an approval process for changes or allow direct changes by an instructor without going through an approval process. When the approval process is enforced, special procedures track the parties who respond to a certain change-proposal and notify instructors when all parties involved have approved a change-proposal so that it can be applied.

4.4 Applying and discarding changes and providing warnings

As mentioned earlier, all changes made by instructors, including those that received approvals, are saved temporarily in the "proposed changes" table in the course

"changes" database. When a change is applied, it is then saved in the "applied changes" table. It is possible that some instructors may not respond to some change proposals in a timely fashion. To avoid this, an automated warning system tracks all changes and continuously reminds instructors to respond to pending change-proposals. SQL statements are used to automatically query the changes database and obtain the status of all change proposals. If a response to a proposed change is not provided, a warning message will be sent to remind instructors to respond.

5. Case study

A simple hypothetical case study is presented in the following subsections to demonstrate the features of the proposed system. It is assumed that the "construction engineering and management" area of specialty has three instructors ("EssamZ", "PeterP", and "SuleimanA"). It is also assumed that the instructor with a user name "EssamZ" is using the system and will add new topic/material and modify/update an existing one. The following subsections explain the detailed use of the system, how a change to a course material is proposed, how a change proposal is approved and then applied, and how students receive instant notifications of course material changes and new uploads.

5.1 Logging in to the system

The first step is to securely login to the system, as shown in Figure 4. Each user has his/her own password that enables him/her to access the system. This access control is important so that each user can only access the required data in full security and without interfering with others' work. Once the access is allowed, the instructor can view courses in his/her area of specialty and see topics, assignments, lecture notes, and exercises related to a selected course. The system user can also view the history of changes made to the selected course material. Figure 4 shows that the user selected the "project scheduling with uncertain durations using PERT" topic for the "construction management" course in the first semester 2009/2010.

5.2 Opening an existing course material

The second step is to open existing course material related to the selected topic. Each course material in the list is linked to a file. The file can be an MS PowerPoint, MS Word Document, MS Excel, MS Project, or Adobe Acrobat file. As soon as the user clicks on the combo box to select a topic, the system will access the selected course material database and then access the appropriate tables in the database to list all files available for the selected course topic. As shown in Figure 5 for the "project scheduling with uncertain durations using PERT" topic, the system lists four default files for lecture notes (.ppt), exercise 1 (.doc or.docx), exercise 2 (.xls or.xlsx), and exercise 3 (.pdf) and make them ready for downloading. When the user selects a certain course material, the system will access the file linked to this course material and open it. If the user decides to open the selected file, he will be asked to provide a password. If the user is not the creator of this file, he/she will not be able to make any changes to the file and can only view the file in the "read only" mode, as shown in Figure 5.

5.3 Uploading new course material

Only the system administrator can add a new semester or a new course to the system database. Instructors can only add a new topic or a new course material. To add a new

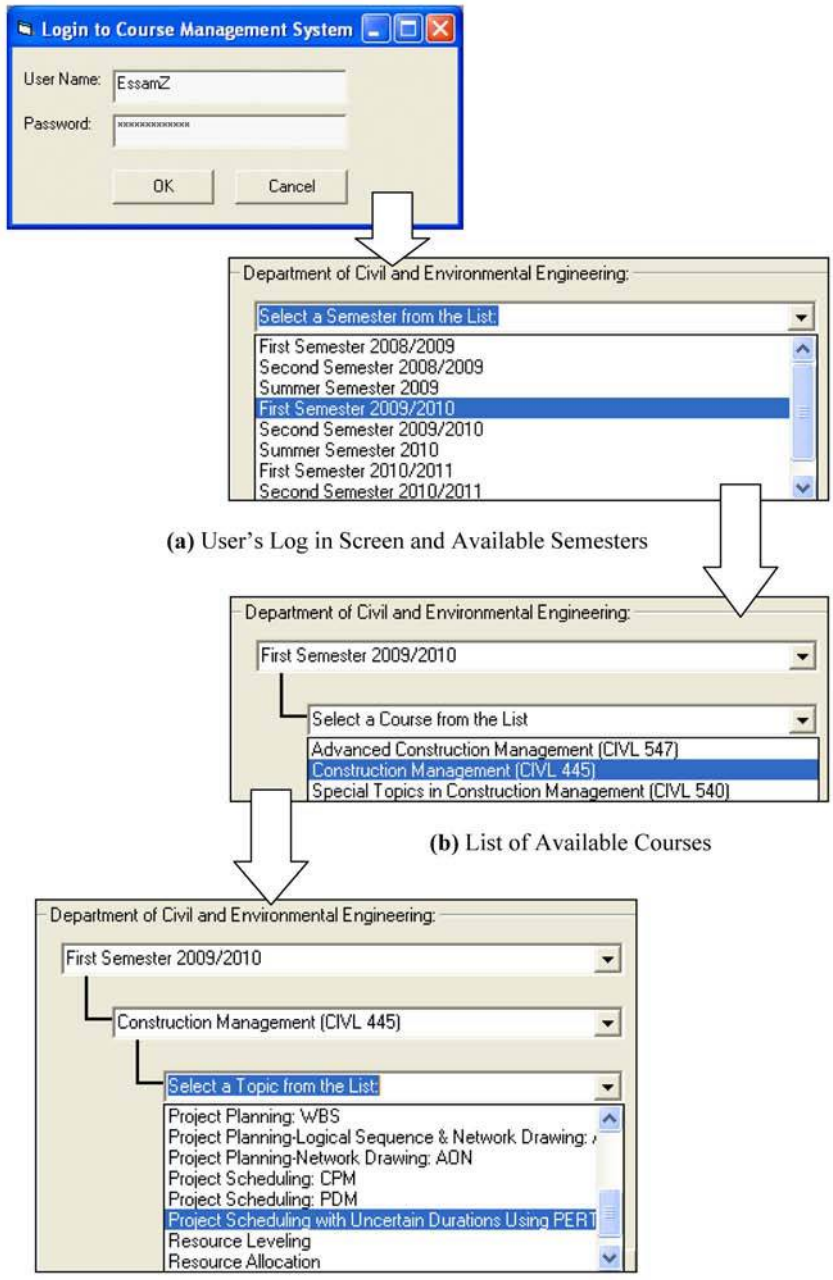

Figure 4.
Using the system to view an existing course topic

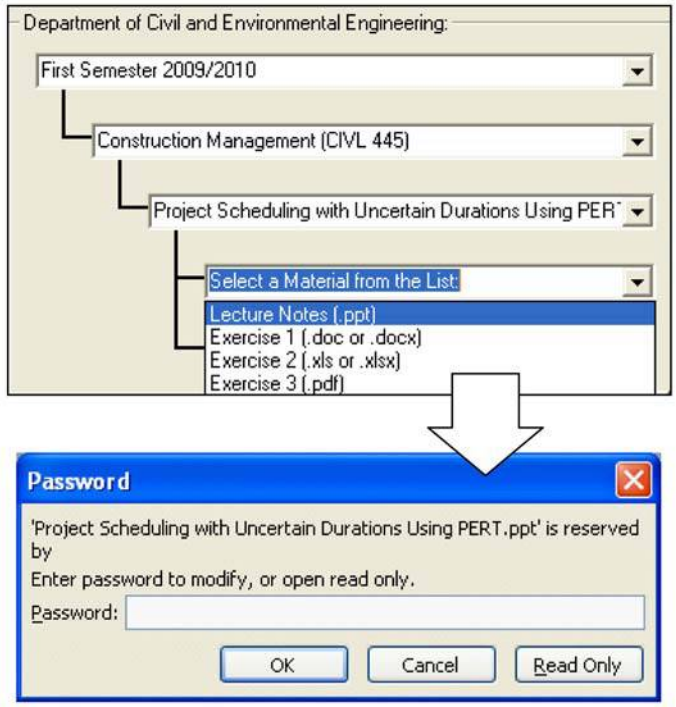

Figure 5.
Example of opening PowerPoint notes for a certain topic

topic, the instructor needs to click on the "add a new topic" button shown in the bottom of the first screen capture of Figure 6 and enter the name of the new topic. As shown in the figure, the instructor added the "types of contracts" new topic. This new topic will be automatically added to its corresponding database and will also be listed in the topics combo box. To add a new course material, on the other hand, the instructor needs to click on the "add a new material" button shown in the bottom of the first screen capture of Figure 6. The instructor should select the new material type and the file type. The instructor will then be asked to select the topic name from the available list of topics to which the new material will be linked, as shown in the bottom screen capture of Figure 6. As shown in the figure, the instructor added a new "types of contracts" PowerPoint lecture notes.

To achieve the required level of security, each group of instructors in the same area of specialty saves their own course data only. The databases are stored in a central repository. Instructors can only access and work on their related courses that appear in the "list of courses" combo box. Access of any party to its own course material database gives full use/modify/save control while access to courses list database gives view-only control.

5.4 Proposing changes and applying change proposals

An instructor can use the system to add a new file or change/update an existing file. The system does not differentiate between adding a new file and changing/updating an existing file and both will be dealt with as uploading a new file. Before doing this, a

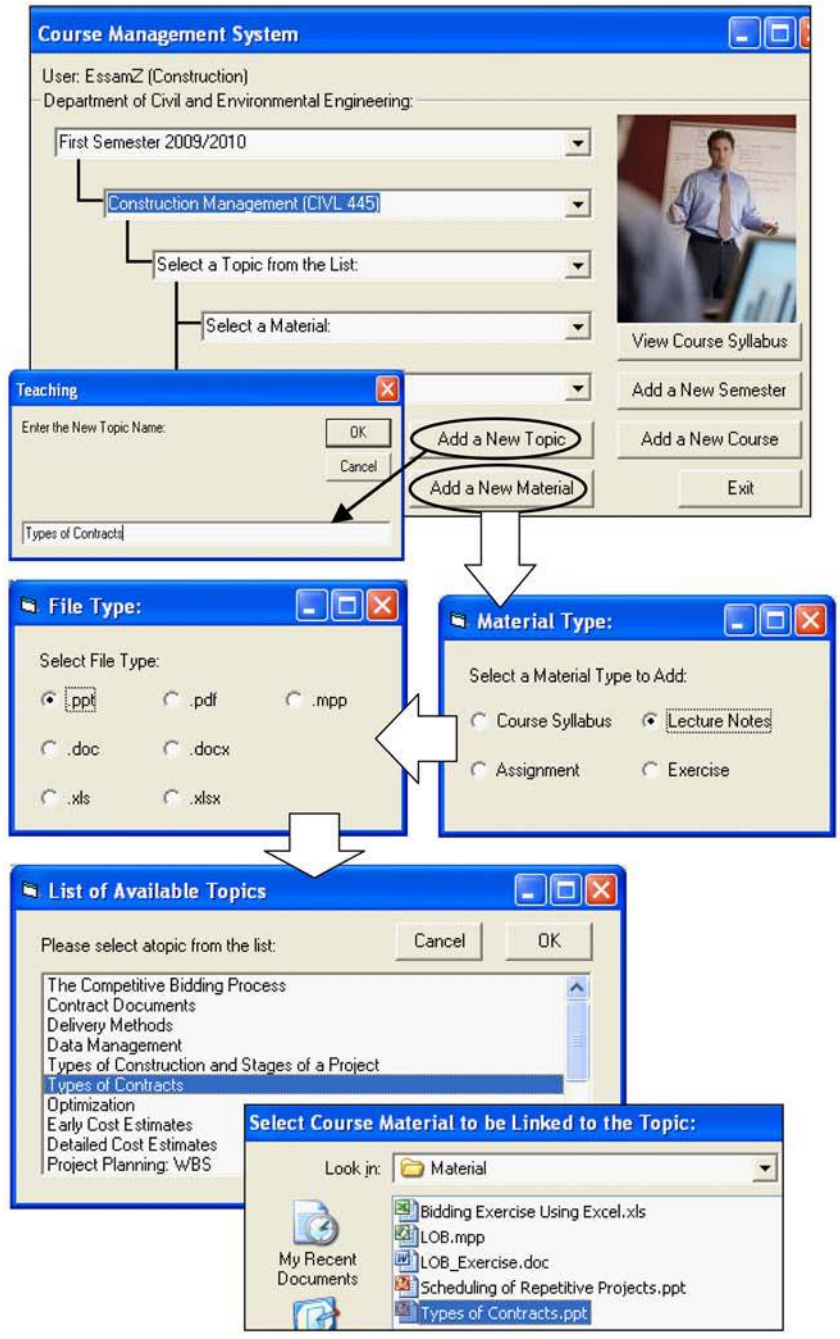

Figure 6.
Adding a new topic or a new course material

"change proposal" should be sent to all interested parties. Interested parties are defined as the system administrator, students, and instructors in the same area of specialty. Once a change is proposed, it is communicated to all interested parties and then stored in the "proposed-changes" table of the course "changes" database. In this case study, instructor "EssamZ", for example, proposed to update the "delivery methods" lecture notes by adding a new section to it. This new section explains the "build-operate-transfer" (BOT) type of delivery methods in detail and highlights its advantages and disadvantages. The system administrator and other instructors in the same group/area of specialty ("PeterP" and "SuleimanA") received this change proposal. For example, Figure 7 shows that instructor "PeterP", received this change proposal and approved it. The role of the system administrator is to follow up on this proposal and make sure that all other instructors respond to it in a timely manner; otherwise they will receive warning messages from the administrator. Instructor "EssamZ" can also view the status of other instructor's approvals/disapprovals on his/her proposed change, as shown in Figure 8. Once all instructors approve the proposed change, the "apply change" button shown in Figure 8 becomes active and "EssamZ" can go ahead and apply this proposed change. All types of changes are stored in different databases/tables for future view and follow up by the administrator who, in turn, provides the necessary warnings to all instructors, as applicable.

5.5 Receiving notifications of applied changes and changes reports

When a change is applied by an instructor, other parties will be instantly notified through automatically generated emails and messages informing them that a change has been applied. As shown in Figure 9, student "SalehM", who is registered in the "construction management" course and instructors "PeterP" and "SuleimanA" in the construction engineering and management area were instantly notified with the change applied by instructor "EssamZ". In addition to these change notifications,

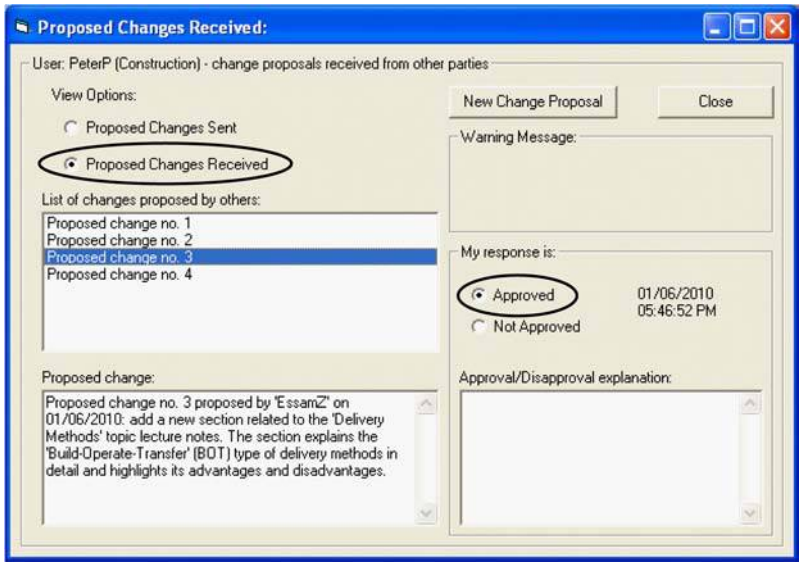

Figure 7.
Example of list of changes received by an instructor

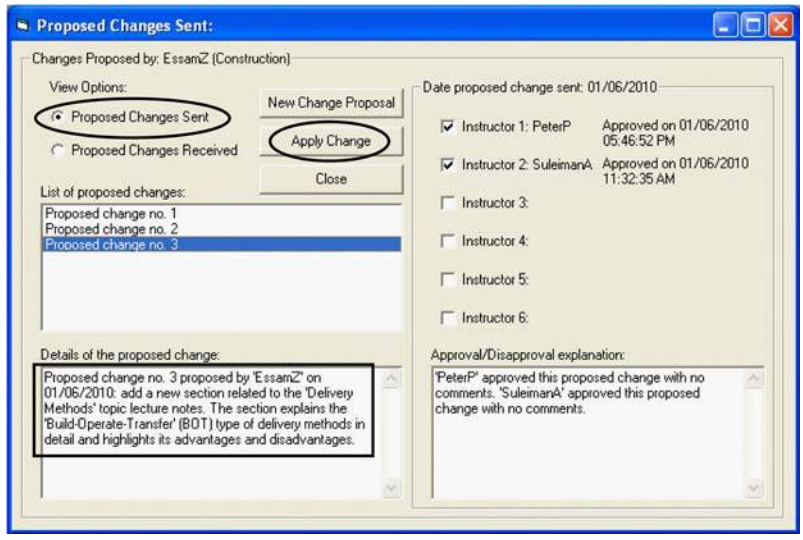

Figure 8.
Approvals of instructors to a proposed change

system administrator and course instructors can view reports of proposed changes and applied changes. Sequential query language (SQL) statements are used to automatically query course databases and obtain the changes made by any instructor. Figure 10 shows an example report of the applied changes made by the

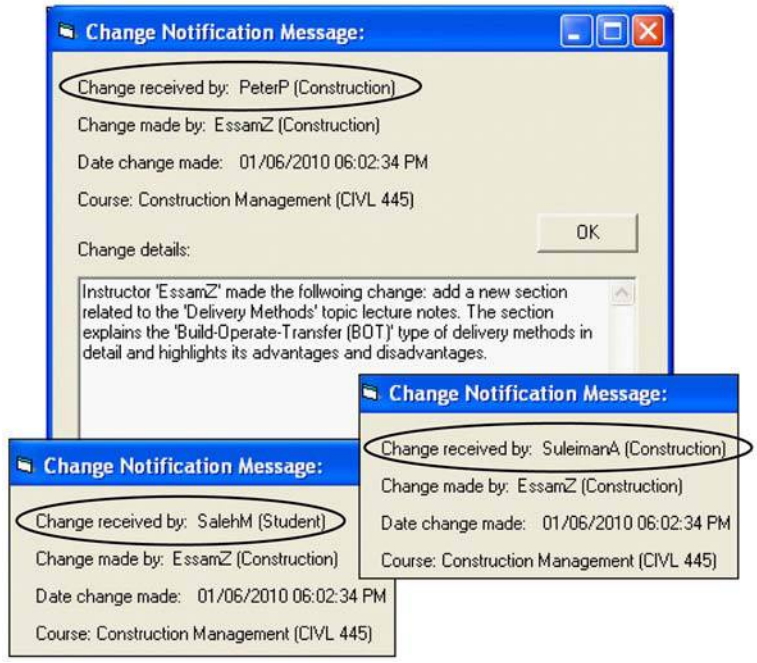

Figure 9.
A change notification received by other parties

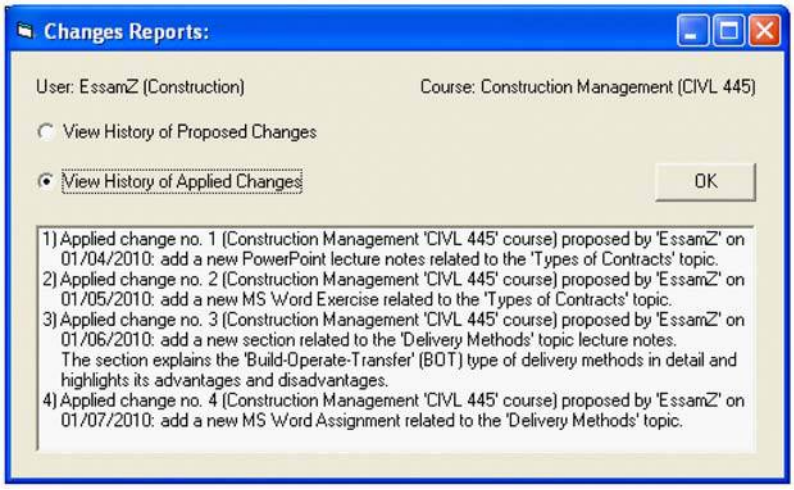

Figure 10.
List of changes for the "construction management" course

three instructors in the "construction engineering and management" area of specialty. This report can be viewed by clicking on the "view changes history" button shown in the bottom right of Figure 2.

To further validate the developed system, it was also tested in real-life for a course in the civil engineering department allowing access to the course instructor and to students registered in the course. For testing purposes, the instructor added different course material and introduced several changes to course material. Students were impressed with the instant notifications they received each time a course material was added/changed.

6. Conclusions

This article presented the developments made to a dynamic system for the management of changes made to civil engineering courses in a university in the United Arab Emirates. The proposed components of the system were developed using the powerful capabilities of visual basic programming language to provide instructors and students with an easy access to course material in a collaborative environment. It also provides instructors with a dynamic mechanism to upload and modify/update course material effectively and securely. Instructors can view, modify, and add course topics, lecture notes, exercises, and assignments in different formats. The novel aspect of the developed system is its mechanism for managing changes made to any course material and informing all parties affected by such changes in an effective and timely manner. The study introduces the system administrator as a main party. The main role of the administrator is to add new courses and semesters, determine and preset the paths required for each course to communicate changes, follow up on change proposals, and track changes made to all courses. The system was also tested in real-life for a course in the civil engineering department and students were impressed with the instant notifications they received each time a course material was added/changed. The developed system incorporates a client-server environment and uses Microsoft Windows NetMeeting as a main tool for collaboration. Implementation issues were

discussed and a case study was then presented to demonstrate the capabilities of the developed system. As a future extension to the present study, the author is currently working on the developments necessary to integrate the system with additional and important modules for online tests, course grades, and course assessment. The details of the developments of these modules and their integration with the system will be presented in a future research paper along with the use of the system by other departments and colleges. The developments made in this study and the availability of visual basic as a powerful programming tool will help in developing other useful applications for teaching.

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