TEACHING MECHANICS WITH MULTIMEDIA TOOLS

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Abstract

In the present paper, teaching Engineering Mechanics with multimedia tools is emphasized. The web site design for online teaching has been discussed. The combination of the traditional and Internet teaching is featured. Namely, the traditional teaching is combined with the Internet teaching. Two engineering courses are currently being taught with such combination. A comparison for teaching engineering courses with and without the Internet has been conduced. Experimental results from the different teaching approaches applied in the course of Engineering Mechanics show that student's learning ability has been improved and that students' study in engineering is more self-motivated and efficient. The Internet teaching not only provides an alternative way to pass knowledge and to enhance students understanding of principles taught in Engineering Mechanics, but also it offers more flexibility and convenience to help students in learning.

I. Introduction

The traditional "chalk and talk" mode has been employed in teaching of engineering courses for many years. For this teaching pattern, an instructor usually shows up two or three times per week to give lectures. The instructor assigns homework regularly and gives quizzes and exams to students in order to enhance student's understanding of their learning and to obtain important feedback information from students at the same time. During a lecture, students take class notes and ask questions. Such a pattern obviously has some problems. For instance, the one-hour lecture may be too short to solve student's problems or to answer student's questions. The availability or accessibility of an instructor after lecture hours is one of important key issues in teaching of engineering courses. Today, with help of high technology of telecommunication, the teaching of engineering courses can be improved greatly with many ways. Teaching engineering courses through the Internet is one of them (1, 2, 3, 4, 5 and 6).

The Internet is a "web" of high-end servers that allow sharing of information. The Internet has many advantages that educational institutions can use to benefit the students. Using the Internet as multimedia tools to teach engineering courses is a good example. Today, electronic distribution of teaching materials such as Asynchronous Learning Networks is becoming commonplace. More and more learning institutions start to employ this new technology or software such as WebCT to benefit higher education. This paper, however, presents a self-

designed web teaching method that gives lots of flexibility to instructors who want to build their own web teaching site.

II. Web Page Design for the Course of Engineering Mechanics

At the Department of Civil Engineering in School of Engineering, Morgan State University, two courses are being taught through the Internet. One of them is Engineering Mechanics (CEGR304). For purposes of comparison, this course (i.e., CEGR304) is also taught through regular lectures in classrooms with the traditional way. The self-designed web site for Engineering Mechanics is designed as one main page combined with three parts: 1) *COURSE INFORMATION*, 2*) LECTURE*, and 3) *PROJECT*.

The *COURSE INFORMATION* has six components (or sub-pages) which are listed as follows: *Syllabus*, *Class Notes*, *Outline*, *HW Tips*, *Attendance*, *Grades* (see Figures 1 for the main page design). Although each category is self-explanatory, it is worthwhile to explain each of them in the following paragraph:

1) *Syllabus* gives the brief information of this class including the instructor's information such as name, office and lecture hours, room and phone numbers, etc.), the course scope, the textbook adopted, policies for assignments, exams as well grading and attendance, etc.. Since it serves as guidance in any course, it is important for students to review it from time to time when it is necessary. At the same time, the instructor can revise the some policies of this course when it needs to do so;
2) *Class Notes* not only provides supplemental details of the lecture notes that the students obtained in the classroom, but also helps students who are not able to attend the class due to various reasons such as sickness, car accident, family emergency, etc. One can access the class through the Internet for his lecture notes if one is physically absent for that class. This section also allows students to prepare for this course in advance.
3) *HW Tips* helps and encourages students to overcome difficulties in homework. This section serves two functions. A student either can consult this section for homework tips when he or she encounters problems that is difficult to be solved or can raise questions or post his or her opinions into this page to share with others. For the instructor, it can be used as a section to post good solutions from students and to post special announcement of courses. In other words, this section plays an important role in communication between students and the teacher;
4) *Attendance* is the page to keep the records for student attendance. Attendance is mandatory and is also a part of student's grade for the engineering courses, it is, therefore, important to encourage students to review this section and to involve activities of the class;
5) *Grades* provides a window to allow any student to watch his or her standing and performance closely in the class. Grades in this course include ten assignments of homework, ten quizzes and two comprehension tests plus the mid-term and final exams. Allowing the student to check up on his or her status may provide the driving forces for students to maintain a better record. It will also inform the students how much their grade exceeds or falls short of their goals. In order to provide some confidentiality the last 4 digits of each student's social security number are employed as a personal identification number. On the other side, for an instructor, the section serves as a key source of feedback from student's learning. Accordingly, the teaching can be monitored and revised.

One can design more components for this part if it is necessary. In Environmental Engineering I (CEGR328), for an example, three more sub-pages *Field Trip*, *Project* and *Lab Work* are added to this course at the web site correspondingly.

The *LECTURE* is designed specially for delivering lectures through the Internet. The lectures are given by the online slides. To prepare an online lecture, it needs three steps. The lecture is prepared at a local environment using MS PowerPoint, a component of the software package MS Office 97. Then the slides for the lecture are designed and saved to the format of HTML files with images. Finally, the file needs to be uploaded to the web site for teaching. The instructor can also add or revise the lecture at anytime and from anywhere he can reach to the web site. For instance, when the instructor is out of town to participate a conference, he or she still can give the lecture if the access to the Internet is available.

The *PROJECT* is designed for demonstration of undergoing research projects with pictures and presentations including project design (literature review, scope, methodology and expected results), laboratory information (device or equipment) and project discussions (online talks or seminars). This part allows student to involve current projects and to initiate new senior projects which are one of the requirements for graduation in the Department of Civil Engineering.

Further improvement of the web site teaching will concentrate on the design for online assignments such as homework, quiz and comprehensive exams. Technically speaking, in the design of pages themselves, HyperText Markup Language (HTML) has been utilized. Embedded also are Java scripts. These simple technological utilities are applied to develop a greatly multimedia tools to help engineering students taking the course of Engineering Mechanics at Morgan State University.

III. Analysis and Discussion of Results

The results from traditionally teaching Engineering Mechanics are compared to those from the traditional teaching combined with the Internet teaching. Such comparison is based on the same conditions, namely, using the same textbook and materials, the same number of assignments (e.g., ten homework and quizzes given weekly) as well as the same tests and exams materials (e.g., the same problems for two comprehensive tests plus the mid-term and final exams). The grades from the courses taught in 1997 and in 1998 are listed in the Table 1 and drawn in Figure 2.

In Table 1., the grades for the semester of fall 1997 are from the courses taught in the traditional "chalk and talk" way. In contrast, the grades of the courses for the semester of spring 1998 are combined with the Internet teaching. Experimental results of Internet utilization in teaching show that students' grade are improved. The average grades from two comprehensive tests, mid-term and final exams, as well as ten quizzes respectively have increased by 2%, 10 % and 12 %. Such improvement illustrates the fact that students who study in the engineering courses are more self-motivated and efficient with this combined teaching method. This conclusion is based on the average grades in Table 1 compiled during the two consecutive years' teaching (Fall, 1997 and Spring, 1998). Experimental results indicate that students' capacity of learning has been,

overall, increased by 8 % which is close to an entire letter grade. More data are expected to obtain from the current teaching, namely, the semester of fall of 1998.

Table 1. Comparison of Grades

Semester in School Year	Average Grades		
	Tests	**Mid & Final Exams**	**Quizzes**
Fall 1997	74.0%	73.9%	75.0%
Spring 1998	75.4%	80.9%	83.6%

From the results one can conclude that the World Wide Web not only provides an alternative way to pass knowledge to students, but also it creates an environment with more flexibility and convenience for both the teachers and students. Students can readily appreciate the availability of and easy accessibility of help. Those students who have part time jobs and/or unexpected family matters can still maintain discussions of problems with the instructor without being limited by office hours and location. Most of these problems are related to lectures and homework, and can be easily solved by applying the Internet to the traditional teaching. In brief, the fact that students can access the online course at anytime from anywhere increases the student participation in the classroom. Students are not the sole beneficiaries of the well-organized system. Teachers experience increased productivity as well. The teacher can post announcement, quiz or exam answers, homework tips, and comments at the web sites during non-class hours

Remote learning or teaching is another important feature in teaching engineering courses with the combined method. When an instructor is not physically available, lectures also can be delivered. For instance, if the instructor is out of town for a professional conference, he or she can still give a lecture through the Internet. On the other hand, when a student travels for a project meeting, he or she also is able to attend the class through the courses given at the web sites. Overall, refined bi-directional communication between teachers and students plays an important role in helping and improving students' comprehension of principles in Engineering.

In recent years, the usage of the Internet has grown rapidly. After seeing the practical commercial value of the web, educators start to make use of this proven technology to enhance the teaching in educational institutes. The Internet offers the convenience to students and faculty as it does to the whole society. This concept of having information that is accessible 24 hours a day can be comforting to students who may not have understood every idea the professor identified in the classroom. This Internet is readily available for use as a study guide and tutor. In brief, the revolution in the telecommunication and information will affect higher education and push the reform of teaching in Engineering Mechanics.

Obviously, like all other methods of instruction, the Internet teaching does have negative sides as well. Internet access on the part of both student and faculty is required. However, due to the fact that the university offers services of the Internet connectivity this simple but debilitating problem is eliminated. Another argument may be that the Internet and e-mail is too impersonal and

cannot possibly enhance the learning ability of students. This argument might be not true for the case of the combined teaching method discussed in this paper, namely traditional teaching combined with the Internet teaching. The teaching with the Internet is to be used as an extension of the classroom when the actual classroom becomes inaccessible. Since electronic communication provides bi-directional contact (i.e., convenient availability and accessibility) to help students and teachers in learning and teaching respectively, the Internet becomes one of powerful tools in higher education. It is important to point out that computer, however, cannot replace instructor's function. Education cannot survive without educators.

IV. Summaries

In this paper, first, a self-designed web site for teaching Engineering Mechanics has been introduced, in which three parts are included, namely, *COURSE INFORMATION, LECTURE* and *PROJECT*. The self-designed web teaching site is no cost, flexible and convenient. Second, teaching of Engineering Mechanics with a combined method has been conducted with considerable results. Engineering Mechanics in the semester of Spring 1998 was taught in the combined way, (i.e., the traditional "chalk and talk" way combined with the multimedia teaching via the Internet). In contrast, the same course was instructed with the traditional teaching method in the semester of Fall 1997. The observation and analysis of this teaching have been conducted by comparison of the results from this course taught consequently in the semesters of Fall 1997 and Spring 1998. The results from the experiments show that with help of teaching through the multimedia tools via the Internet, student's learning ability has been improved. Based on the comparison on the consequent teaching results of two semesters (i.e., the semesters of Fall 1997 and Spring 1998), student's average grades in comprehensive tests, mid-term and final exams as well as quizzes have individually increased by 2 %, 10 %, and 12 % or have overall increased by 8 %. It is found that students are more self-motivated and confident through this combined teaching approach, and that student's understating of principles taught in this course is improved.

Furthermore, teaching Engineering Mechanics with the multimedia tools via the Internet will expedite reform of traditional teaching in engineering courses. Such reform is necessary and helpful to enhance students' understanding of principles and laws in Engineering Mechanics. Such reform brings a teacher and his or her students closer with better communication. Lastly and perhaps most importantly, such reform improves students' independent thinking, self-motivation, and self-confidence.

Biobliography

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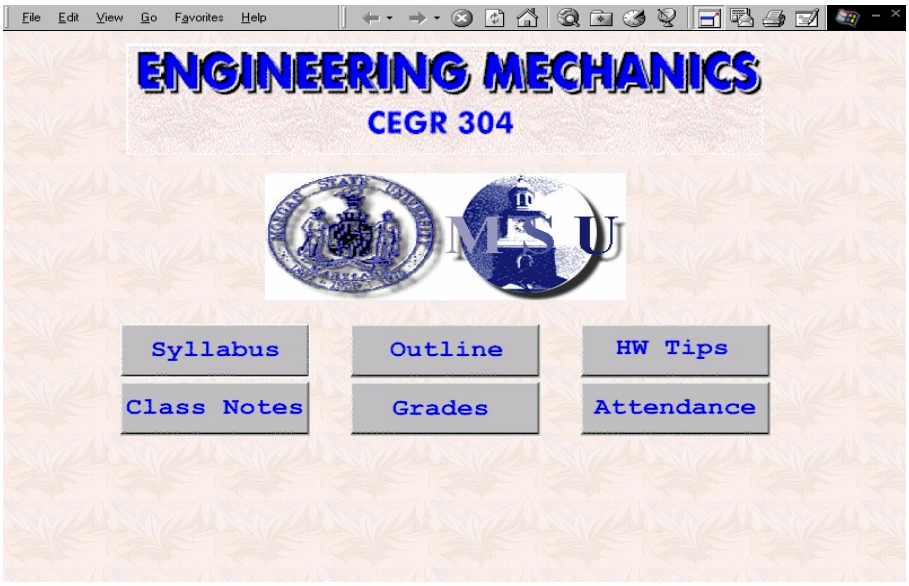

Figure 1. The main web page designed for Engineering Mechanics

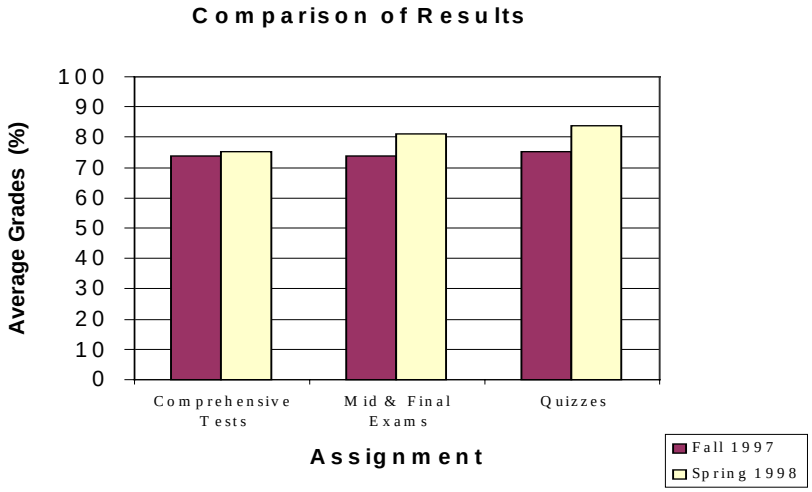

Figure 2. Comparison of teaching results