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Using Technology Mediated Instruction to support an Introductory Structures Course for Construction Undergraduates

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An incremental approach to developing a web site to support an introductory structures course at Texas A&M University is presented. The development of the web site from an initial on-line presence at the start of the Spring 2000 semester through to a fully functioning web site in Fall 2000 is described. The structure of the web site is outlined and the preparation of web lecture pages that contain a mixture of text, graphics and animations is described in detail. A survey conducted among undergraduate students during the Fall 2000 and 2001 semesters provides details of how students use the web site while enrolled in the class. The survey also investigated how students perceived the usefulness of the web site. Results of the survey suggest the web site is a useful tool in supporting an introductory structures course.

Key Words: Structures coursework, Technology mediated instruction, Undergraduate education.

Introduction

The Internet is a valuable resource that can enhance the traditional classroom delivery system. The limitations of the traditional classroom environment and methods of communication make the explanation of introductory concepts difficult. Computer graphics and animations help support traditional classroom lectures. Students in the classroom and other locations, such as a computer lab or home, can access instructional material. The use of the Internet to aid instruction is called Technology Mediated Instruction (TMI) by the Texas A&M University System. TMI is defined by the Texas A&M University system as instructional activities that use technological innovation in the development and delivery of course content to students whether in a traditional setting or through distance education. The use of computers and computer software are considered technological innovations. This paper describes the development of a web site to support an introductory structures course and surveys students on how they use the site and their perception of the sites usefulness.

The Traditional Instruction Method

The Department of Construction Science at Texas A&M University has a group of four structures related courses: COSC320 Soils in Construction, COSC321 Structural Systems I, COSC421 Structural Systems II and COSC422 Structural Systems III. This paper is focused on introductory structures course COSC321. COSC321 covers basic statics and strength of materials concepts. The course has been offered in its current format since the fall of 1998. The

author has taught the class since the fall of 1999. The traditional way of teaching COSC321 is to have three 50-minute lectures and three 50-minute labs each week.

The traditional instructional method involved lecturing to the class and explaining key concepts using models and black and white board sketches. The time constraints on the class, and the instructor's drawing ability produced poor quality sketches. In the lab sessions, students solved problems set from the required text. By the end of the session, the instructor worked through the problems on the board in order for students to check their work and answer questions. The required text includes answers without fully worked solutions.

The Incremental Approach to Technology Mediated Instruction

In 1999 the Department of Construction Science initiated a plan to offer the Master of Science in Construction Management by distance learning. COSC 321 is a required leveling course for career-change students seeking a Masters degree. The leveling courses were selected to be the first courses to be offered on-line. A tentative date for pilot testing the COSC 321 course was set for the Fall semester of 2000. Before the spring 2000 semester, when development for the web COSC 321 class began, there was no online content for this class. An incremental approach to developing a web site is the step-by-step enhancement of existing face-to-face courses that builds on the strengths of online learning into campus-based courses (Eastmond, Nickel, du Plessis & Smith, 2000).

Microsoft web development software Front Page 98 & 2000 was used to develop and manage the site. When the site went on-line, prior to the commencement of the Spring 2000 semester, the following components of the class were included as menu items:

- Syllabus
- Schedule with lecture topics
- Expected student behavior statements
- Basic trigonometry formula

This was the basic information students required at the beginning of the semester. Figure 1 shows a screen capture from the site showing the menu items currently available. Most information on the web site was already in an electronic format as Microsoft Word documents. A minimum amount of work was required to convert these to HTML documents. As the semester progressed the following additions were made to the web site:

- Hyperlinks for weekly homework assignments were added. Homework problem numbers were linked to their respective solutions. These on-line solutions were scans of the solutions solved on traditional engineering paper. The students used these on-line solutions to check their homework.
- Past quizzes and quiz solutions were added as menu items. Quizzes and solution sheets had been prepared using freehand text and sketches. These were scanned and saved as GIF images and then added to HTML documents.

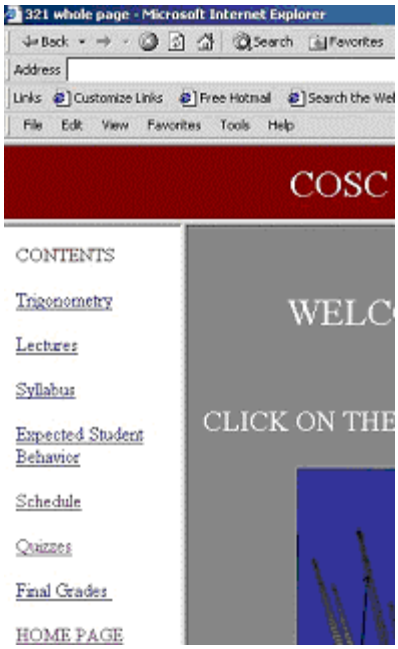

Figure 1: Sample of main navigation of the COSC 321 class

More recently, quizzes have been created using Microsoft Word, with illustrations from Adobe Illustrator. This allows for easy conversion to HTML. By the end of the spring semester, the web site allowed students easy access to support information for COSC 321. The next step involved adding lecture content to the site. The Department of Construction Science obtained funding from the University to help develop web-based material for the Master of Science in Construction Management during the summer of 2000. The author received funding for a six-week period at the end of the summer to produce lecture content for the web site. Lecture material for the web was developed using a combination of text, images, and animations. By using this method the illustrated material could be used in the classroom environment as well. The web lectures are arranged into weekly groups that follow the traditional classroom schedule. Figure 2 shows a screen capture from the week 4 lecture web page. Each week of the semester has a separate web page that contains the following information:

- Readings from the required text
- Web lecture topics with hyperlinks to web lectures
- Homework/Lab problems from required text with hyperlinks to their solutions

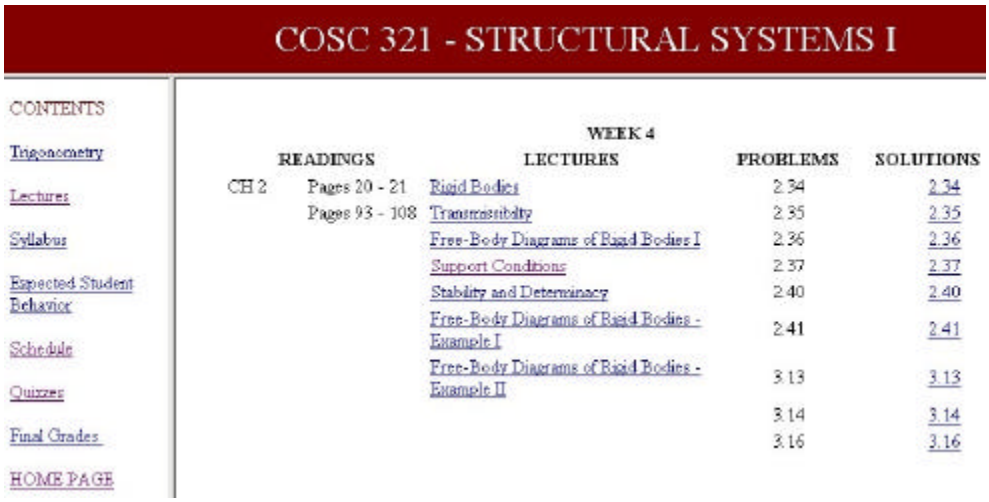

Figure 2: Sample of Week 4 lecture web page

The web lecture pages are a combination of text, graphics and animations. The text content was produced in Microsoft Front Page and the graphics were created using Adobe Illustrator. Tables were chosen to contain content so that resources remained in the same location regardless of screen size (Ryan, 2000). Manipulating the Adobe Illustrator images produced animations; each image was changed slightly to illustrate movement. For most of the animations approximately five to six manipulations were required. Figure 3 shows the five images used to produce an animation of a roller reaction. The animations were produced using JASC Animation Shop software.

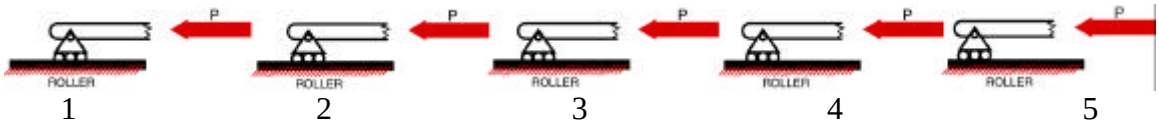

Figure 3: Five images used to produce an animation of a roller reaction

Figure 4 shows a screen capture from a web-lecture page showing the use of graphics, animation and text. The illustration of the pin or hinged reaction is in fact an animation. The animation shows how the force F causes the cantilever beam to move downward from its horizontal starting position. The animation is a loop of five or six images that continues to animate while the page is being viewed. This animation helps to explain to students the limitations of a pin or hinge support condition. Animated files create a sense of motion that can help understanding (Ryan, 2000).

The time spent in developing these web pages depends on a number of factors. Familiarity with the illustration and animation software is a major factor. The amount of graphics and hyperlinks on a particular page will also affect production time. An average of between 15 and 20 hours of development time were spent for the material covered in a 50-minute classroom lecture.

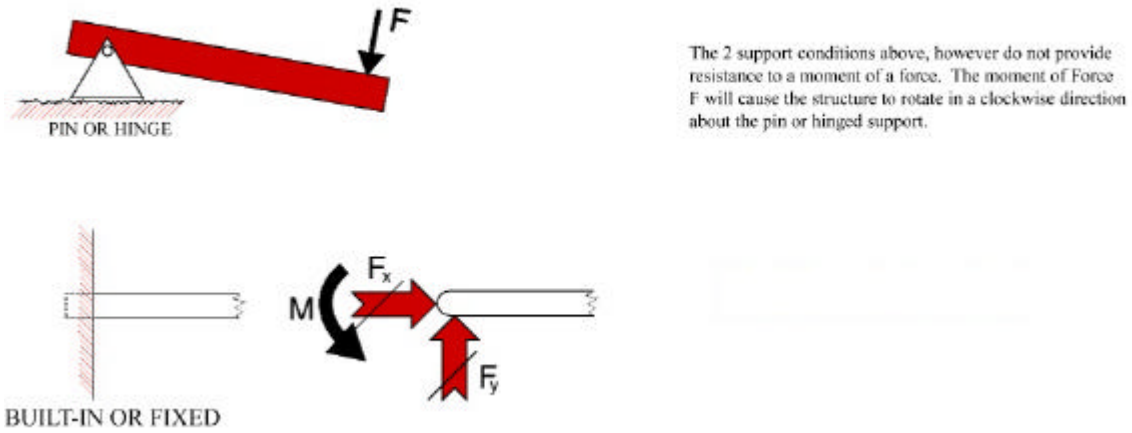

Figure 4: Screen capture of a web-lecture page showing graphics, animation and text.

Student Use Surveys

In order to identify the usefulness of the web site from a student's perspective, a survey was conducted among the students taking the introductory structures class. The surveys were conducted among the Fall 2000 and Fall 2001 classes.

Objectives

The main objectives of the surveys were:

- To identify how students use the web site while they are enrolled in the introductory structures class.
- To ascertain how the students perceive the usefulness of the web site

Method

A short, one-page, survey was given to all the students enrolled in the Fall 2000 and Fall 2001 classes. In Fall 2000 semester there were 97 students enrolled and 115 in Fall 2001 semester. There were 61 completed surveys in 2000 and 74 in 2001, giving response rates of 63% and 64% respectively.

Results

The first series of questions on the survey dealt with how the students used the web site while enrolled in the class.

1. Where is the computer that you usually use to access the introductory structures course web site?

Table 1

Where students access the introductory structures course web site

Location	**Fall 2000**	**Fall 2001**
At Home	52%	56%
College Computer Lab	39%	35%
University Computer Lab	8%	7%
Other	1%	2%

2. How often did you visit the introductory structures course web site?

Table 2

How many times a week students access the introductory structures course web site

How often	**Fall 2000**	**Fall 2001**
Never	2%	12%
Once a week	34%	46%
One to three times a week	46%	38%
More than three times a week	18%	4%

3. When you visit the site, on average, how long do you stay?

Table 3

How long, on average the students stay at the introductory structures course web site

How long	**Fall 2000**	**Fall 2001**
Never visit	0%	1%
Less than 5 minutes	16%	12%
5 – 10 minutes	49%	53%
More than 10 minutes	35%	34%

4. How did you use the web lecture pages?

Table 4

How the students used the web lecture pages

How students used web lecture pages	**Fall 2000**	**Fall 2001**
Never visited them	2%	4%
Visited them only to print the pages to read	45%	49%
Visited them and read the pages on-line	18%	11%
Visited them, read the pages on-line and printed them	35%	36%

5. How did you use the lab/homework problems and solutions?

Table 5

How the students used the lab/homework problems and solutions

How students used the lab/homework problems and solutions	Fall 2000	Fall 2001
Did not use them	8%	12%
Printed them out before the lab to use during lab	18%	23%
Printed them out after lab to check solutions	45%	47%
Other	29%	18%

The second series of questions dealt with how the students perceived the usefulness of the web site.

6. Identify the response that best reflects your response to statement "The Web-lectures helped support the material I was given in the lectures".

Table 6

Students response to the statement "The Web-lectures helped support the material I was given in the lectures"

Response	Fall 2000	Fall 2001
Strongly agree	62%	57%
Agree	26%	32%
Neutral	12%	10%
Disagree	0%	1%
Strongly disagree	0%	0%

7. Identify the response that best reflects your response to statement "The animations in the Web-lectures helped explain difficult concepts".

Table 7

Students response to the statement "The animations in the Web-lectures helped explain difficult concepts"

Response	Fall 2000	Fall 2001
Strongly agree	51%	47%
Agree	34%	39%
Neutral	15%	14%
Disagree	0%	0%
Strongly disagree	0%	0%

8. Identify the response that best reflects your response to statement "If I missed a lecture, the Web-lecture helped to explain the work I missed".

Table 8

Students response to the statement "If I missed a lecture, the Web-lecture helped to explain the work I missed"

Response	**Fall 2000**	**Fall 2001**
Strongly agree	53%	41%
Agree	23%	42%
Neutral	22%	17%
Disagree	0%	0%
Strongly disagree	2%	0%

9. Identify the response that best reflects your response to statement "It was a waste of time visiting the web-site".

Table 9

Students response to the statement "It was a waste of time visiting the web-site"

Response	**Fall 2000**	**Fall 2001**
Strongly agree	0%	0%
Agree	0%	0%
Neutral	0%	5%
Disagree	20%	23%
Strongly disagree	80%	72%

Discussion

The results of the first series of questions give valuable information on how students use the web site while enrolled in the class. The results show the majority of the students access the web site from their home computers. This means that many students will only have access to the web site via slow Internet connections. In these circumstances, the file size of each web page becomes an issue, as graphic intensive pages take longer to load via slow cable modems. The Front Page software has a function that provides details of the time it takes to load a page over connections of various speeds. For example the web page, which contains the graphics shown in figures 3 and 4, is estimated to take 13 seconds to load over a 56.6 modem.

The vast majority of the students taking the class accessed the web site at least once a week and the majority of the students stayed less than ten minutes at the site. This short period of time spent at the web site is most likely explained by the results to question 4 that showed 45% of the students in Fall 2000 and 49% in Fall 2001 only visited the site to print the pages to read. Question 4 also revealed that over 80% of the students print the web pages to read. This raises two points, the first is, what is the point of producing animations when most of the students print the pages and the animations appear static and secondly the clarity of the pages when printed becomes important. The first point is answered by the responses to question 7 that showed that over 85% of the students agreed that the animations helped explain some of the difficult

concepts. This might be due to the fact that the animations are also used during the classroom lectures to help explain concepts. The second issue was addressed by printing out web pages during the construction phase and inspecting for clarity. Students were also encouraged to inform the author of any problems regarding the site and during the early days of the web site most of the complaints were about the clarity of the printed pages. The results to question 5 show that the majority of the students used the problem solutions in some form. The instructor encourages the students to use the solutions to check their own solutions only after they have solved the problems themselves.

The results of the second series of questions reveal how the students perceived the usefulness of the web site. The results of question 6 show that the vast majority of the students agree with the statement that the Web-lectures helped support the material they were given in lectures. This would indicate that the Web-lectures are a useful tool for supporting traditional classroom instruction. The results of question 7 show that the students perceive the animations on the web site as helping to explain difficult concepts. This is a strong argument for developing these animations, even though the time spent in developing them can be long. The students also agreed that web lectures were also useful in helping explain the work they missed if they were absent from a lecture. The results to question 9 would seem to confirm the results of earlier statements, as none of the students agreed with the statement that it was a waste of time visiting the web site.

The results of the student surveys suggest that the web site is a useful tool in supporting an introductory structures course. The results however are based on surveys conducted over two semesters at one university and may not be applicable to other classes at other universities. The results show that the web site is useful to the students but does not address how it improves student learning. Future research will focus on the effect the web site is having on the student's ability to understand some of the structural concepts mentioned earlier.

References

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