

## Construction Education Using the World Wide Web

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### **ABSTRACT**

Lecturing is not the purpose of teaching. The purpose is transferring knowledge. The World Wide Web (WWW) helps in distributing information, but can it improve the quality and effectiveness of transferring knowledge? An Arizona State University undergraduate estimating course employs the WWW to support instructional delivery of technical materials. Cooperative learning, multi-media tools, and other electronic resources enhanced the WWW structured course. This course delivery system, using the latest developments in information technology, enables students and instructor to work closely and cohesively in many new ways. Requiring students to use WWW technology and cooperative learning concepts supports knowledge transfer and enables the instructor to effectively reach individual students. The delivery system builds student interest, supports the development of “people” skills, and enhances student teacher communication. Student surveys show that the system does improve the quality and effectiveness of transferring knowledge

## **I. INTRODUCTION**

Today the world is facing unprecedented challenges in almost every field. At the same time new information transfer systems and technologies are bursting forth. Teaching is a domain that has developed and changed slowly across history. Today, however, teaching is facing new challenges and opportunities due to these new information transfer systems. Teaching per say is not the question. The question is transferring knowledge. This paper describes the use of World Wide Web (WWW) technology as a tool to improve the quality and efficiency of transferring knowledge.

The teaching delivery method has a great impact on the amount of knowledge transferred from the teacher to the student. There is ample evidence that some delivery methods typically adopted by teachers are not very efficient or conducive to transferring knowledge. With the traditional method of teaching, the teacher offers the course material in a classroom where students listen to a lecture, take notes, copy material from the board, execute homework, and complete assignments. In many cases professors fail to transfer knowledge despite personally having a sound technical background in the subject area. It was shown that even the personality (charisma) of the professor has little influence on knowledge transfer (Hastenes et al.,1992).

Research by individuals, research groups, collations, and universities is seeking better instructional methods that improve the quality of knowledge transfer. Several pedagogical methods based on these research studies are currently being applied. Cooperative learning processes, multi-media (MM) educational tools and educational programs using WWW are the primary areas of development efforts.

Today, various academics are attempting to use the WWW as a teaching delivery tool. Efforts are also being made to integrate other new technologies and teaching methods. The use of multi-media and cooperative leaning, and the joining of the WWW and MM applications are examples of these combinations.

An Arizona State University undergraduate estimating course, in the Del E. Webb School of Construction (DEWSC), uses the WWW as a instrument to support knowledge transfer. This paper discusses the DEWSC effort into using the WWW to improve the quality and efficiency of delivering college level construction courses.

## **II. THE ART OF TEACHING**

The word “pedagogy” could serve as the title of this section. Etymologically the word pedagogue means " leader of the children." It is not the traditional teaching methods we are seeking to examine. We are seeking a better method for transferring knowledge through teacher leadership and student participation.

### ***Cooperative learning***

Cooperative learning is an instructional approach in which students work in small groups to accomplish a common learning goal. It is not the same as traditional groupwork, in that most cooperative learning models adhere to the following principles (The Consortium for Instructional Innovation, 1995):

1. The tasks are carefully designed to be suitable for teamwork.
2. Positive interdependence and cooperation is necessary for students to succeed.
3. Students are individually accountable for learning and participation.
4. The role of the teacher changes from being the “sage on the stage” to “the guide on the side,” hence our reference to the etymology of the word pedagogue.

Team formation strategy is an important aspect of the cooperative learning process, because successful accomplishment of the exercises depends upon the structure of the team.

### ***Multimedia Educational Applications***

During the past decade, there has been a proliferation of multimedia technologies for teaching at various academic levels. MM with its digital transformation and control of multiple modes such as voice, music, sound effects, printed text, still images, video, and animation can be very attractive to students. There are real advantages when teachers use MM tools as part of an education delivery system.

1. Reliable access and recall of information stored in the computer rather than having to write on a chalk board.
2. Adding, editing, and updating of lecture material is quick and easy, whether the material is text, video clips, or still images.
3. Instructor designed MM educational applications are tailored for the specific purpose and do not include irrelevant information.

The Chronicle of Higher Education’s survey of university academics found that only 4% of those surveyed use MM and CD-ROM materials in the classroom. This is a surprisingly low percentage, especially with the growing interest in MM for education and business. Part of the reason for this lack of use is an unwillingness by some faculty to inject this new technology into the classroom (Liebowitz & al, 1996).

According to Iskander (1995), recent studies shows that computer-aided instruction (CAI) provides a significant opportunity to improve the quality of teaching and can be very cost-effective. It has been reported that CAI may achieve a 50% increase in student retention,

a significant improvement in the learning rate, an increase in course completion, and a decrease in overall course delivery cost, particularly when distance learning is involved.

### ***Internet Applications***

The Internet is transforming learning by removing the requirement that students be at the same place as their laboratories, their mentors, or their collaborators. Data can be acquired from remote sites, teachers can advise from anywhere, and peers can communicate with each other from multiple locations around the world. New opportunities for decentralized study go beyond telecommuting, which implies merely connecting two locations. Internet technology not only provides links between home-based and school-based activities, but it redefines what is meant by a “school” (Friedman & al, 1996).

Many institutions have set up distant learning programs using the Internet. According to Partee (1996) interactive use, in special classrooms, allows effective learning at sites far distant from the central campus and transmitting data through the Internet enables virtually instantaneous interaction between instructor and student at any distance.

The Internet communication technology can serve as an extension of traditional classroom instruction. This is simply an alternative to personal interaction between teacher and students in a traditional classroom situation. The Internet can enhance the three major activities of all teachers: to counsel students individually, to deliver general information (lecture), and to encourage discussion (Partee 1996).

### **III. THE DEWSC ESTIMATING COURSE**

During the Fall 1996 and Spring 1997 semesters at the Del E. Webb School of Construction, Advanced Building Estimating was taught as a WWW based course. At the end of the semesters, the effectiveness of the system was evaluated by the students and the instructor.

A WWW homepage was created for the course. The main purpose of this page was to give the students administrative instructions and other details related to the course organization and structure. There were other pages that linked to this main instruction page. These included course schedule and lecture notes, homework assignments, teams organization, and grading pages (Figure 1.).

The schedule page included the lecture notes related to the class periods. The notes were available from this web page for the students to download. The lecture notes prepared by the professor were designed using the Microsoft (MS) PowerPoint and Adobe Photoshop software. Because some students had difficulty downloading the material using the latest version of the Microsoft software, the students were given an option to download the lecture notes using either MS PowerPoint version 7.0 (for Windows 95) or version 4.0. Further, some lecture notes were prepared using the HTML language so that the students

could view the notes before downloading. Usually, the notes were available to the students at least one day prior to the class period.



**Figure 1:** Home Page of Advanced Building Estimating Course

Teams were organized by insuring equal average grade point indexes for each team. Then the team organization was modified based on estimating experience and the students' course objectives. Five students did not submit the team organization information for the Fall'96 semester. Those five students were organized into a separate team.

Some homework assignments were placed on the WWW shell. There were two systems adopted in this regard.

1. The first system required the students to submit only the answers by email through the Internet page. The professor graded the homework as soon as received and sent the grades via email back to the individual students.

2. The second system required the students to submit both answers and calculations through the Internet page.

At the inception of the course, all the students were directed to obtain an email address. Email was used extensively for communication between the professor, and the students. The students were directed to email the professor at any time for assistance. As expected there was a significant exchange of emails.

Several cooperative learning concepts were used during the semesters.

1. There were two major group projects during each semester. The student teams prepared a comprehensive bid estimate for both of these projects. The students were also required to submit partial project work at specific intervals.
2. Additionally each team was assigned an in-class presentation related to estimating procedures. These student presentations were later made available to the other students from the WWW shell.
3. A few assignments were made during class periods and the student teams were given a limited in-class time duration to submit the assignment.

#### **IV. EVALUATION OF THE COURSE**

Each semester the success of this new teaching delivery system was evaluated by the students and the instructor.

##### Perception of the System

In the Fall 1996 semester, the majority of the class, 75% felt that “overall use of email and the WWW” was a good method for conducting the course. This percentage increased to 80% in the Spring 1997 semester. The following are student the reasons why the system is good.

1. The WWW provided easy access to course information.
2. Allowed the student to extract the notes before the class period.
3. Easy to communicate with the Professor using email when Professor was not available at the school.
4. High quality of notes and an efficient system compared to other classes.
5. The opportunity to submit assignments from home/office without coming to school.
6. Better coordination between the Professor, and students because of constant communication.

Negative comments centered on two points, lack of Internet access from home and a view that using the net is difficult. Additionally one student felt that the system is counter productive to learning and that the teacher no longer taught in the classroom.

### ***Class Notes on the Internet.***

The students prefer downloading class notes using MS PowerPoint as opposed to the HTML format. In the Fall 1996 semester, downloading notes using MS PowerPoint was endorsed by 63% of the students. A small group, 3% of the class had no comment on the issue. In the Spring 1997 semester 65% of the students preferred the PowerPoint method of downloading. Students favored having the opportunity to download the class notes because:

1. Less note taking required during the class period.
2. Can concentrate on presentations during the lecture.
3. Can read the notes before coming to class. This improves understanding of the lecture in a practical subject like estimating.

The following are the reasons that students rejected the option of downloading notes from the computer.

1. Students do not have the specific software/home computer and encounter problems in downloading notes outside the school computer facilities.
2. Encountered problems in downloading the notes due to network errors or computer errors.
3. It consumes a lot of time to download notes that have graphics or scanned objects/pictures.

Some students suggested reducing the amount of graphics and including more text to increase the material content.

### ***The Teams***

Many of the course exercises were assigned as team projects. The teams were formed based on personal information supplied by each student. The student's current GPA, grade obtained in the pre-requisite estimating course, practical estimating experience, and individual objectives were factors considered in forming the teams. Those individuals who did not submit the data were placed in an unstructured team.

In the Fall of 1996, six teams out of the seven were formed using the student data and 69% of the students were happy with the teams to which they were assigned. A much higher percentage, 90% liked their teams in Spring 1997 course.

Since most evaluation questions are related to the interaction which transpired in the groups, it is best to view the comments based on the structure of the groups. Table 1 depicts the response concerning how the students viewed their groups.

**Table 1.** Student Team Perceptions

Fall 1996	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6*	Team 7 <sup>#</sup>
Number in team	5	5	4 <sup>+</sup>	5	5	5	3
Happy with team	60%	80%	25%	100%	80%	60%	100%
Spring 1997	Team 8	Team 9	Team 10	Team 11	Team 12 <sup>#</sup>		
Number in team	5	5	4	4	4		
Happy with team	100%	100%	33%	100%	25%		

\* unstructured group, + one student withdrew from the course, # graduate students

It is interesting to observe the correlation between student perception of their team and their actual course grades. The Table 2 shows the average grade of the teams. Team 6 was the unstructured team in Fall 1996 semester and its performance was very poor compared to the others.

**Table 2.** Team Performance

Team	1	2	3	4	5	6	7
Ave. Grade	2.8	3.2	2.75	3.2	3.0	1.4	4.0
Team	8	9	10	11	12		
Ave. Grade	3.40	3.60	2.75	3.25	3.50		

The undergraduate Team 4 (100% team satisfaction), Team 2 (80% team satisfaction), and Team 5 (80% team satisfaction) had the highest average grades in the fall. The Team



3 whose team satisfaction was 25%, obtained the lowest average grade among the structured teams. In the spring the undergraduate Teams 8 , 9, and 11 with 100% team satisfaction have the highest average grades. Team 10 whose team satisfaction was 33%, obtained the lowest average grade among the teams.

Table 3 provides student comments about their respective team efforts and problems.

**Table 3 :** Advantages and Disadvantages of working in Teams

Team	Advantages	Disadvantages
1	<ul style="list-style-type: none"> <li>▪ Committed to complete what needs to be done</li> </ul>	<ul style="list-style-type: none"> <li>▪ Difficult to coordinate due to schedules</li> <li>▪ Unorganized and must have a leader</li> </ul>
2	<ul style="list-style-type: none"> <li>▪ Generally committed to work. Valiant effort towards completing the projects</li> </ul>	<ul style="list-style-type: none"> <li>▪ Student schedules not compatible</li> <li>▪ Some members do not care</li> </ul>
3		<ul style="list-style-type: none"> <li>▪ Difficult to meet due to schedules</li> <li>▪ One student dropping out of the class created extra work to the others</li> <li>▪ Lack of communication and effort</li> </ul>
4	<ul style="list-style-type: none"> <li>▪ Easy to work together</li> <li>▪ Everyone contribute</li> </ul>	<ul style="list-style-type: none"> <li>▪ Need extra effort to be organize</li> <li>▪ Difficult to meet due to schedules</li> </ul>
5	<ul style="list-style-type: none"> <li>▪ Good attitudes and hardworking</li> </ul>	<ul style="list-style-type: none"> <li>▪ Difficult to gather due to schedules</li> </ul>
6	<ul style="list-style-type: none"> <li>▪ Very good coordination</li> <li>▪ Good combined knowledge of the construction</li> </ul>	<ul style="list-style-type: none"> <li>▪ Some students do not participate</li> <li>▪ Less motivation for quality work</li> <li>▪ Difficult to gather due to schedules</li> </ul>
7	<ul style="list-style-type: none"> <li>▪ Shared a level of commitment</li> <li>▪ Easy to coordinate due to only three members</li> </ul>	<ul style="list-style-type: none"> <li>▪ For larger projects/ assignments, difficult to cope up with amount of work due to fewer members.</li> </ul>
8	<ul style="list-style-type: none"> <li>▪ Everyone concerned about doing a good job</li> </ul>	<ul style="list-style-type: none"> <li>▪ Scheduling meetings</li> </ul>
9	<ul style="list-style-type: none"> <li>▪ Evaluate solutions closely</li> </ul>	<ul style="list-style-type: none"> <li>▪ Setting up a time to meet</li> </ul>
10	<ul style="list-style-type: none"> <li>▪ Experience of team members seems to be well balanced.</li> <li>▪ Communicate</li> </ul>	<ul style="list-style-type: none"> <li>▪ Do not work as a team</li> <li>▪ Seldom work together</li> <li>▪ Schedule conflicts</li> </ul>
11	<ul style="list-style-type: none"> <li>▪ Everyone takes responsibility</li> <li>▪ Serious about accomplishing the goals</li> </ul>	<ul style="list-style-type: none"> <li>▪ Get little lazy</li> <li>▪ Lot of work to divide up</li> </ul>
12	<ul style="list-style-type: none"> <li>▪ Everyone contributes</li> </ul>	<ul style="list-style-type: none"> <li>▪ No plan and schedule conflicts</li> </ul>

### ***Submitting Assignments over the Internet***

A few assignments were placed in the course WWW page. Students were required to submit those assignments through the Internet. On one occasion the students submitted

both their answers and the calculations through Internet. The Professor replied to the submitted assignments and issued the grades through email to the students. In the first assignment, the marked answers and the grades were issued as soon as the assignment was received from the students.

Half of the students in the fall 1996 semester approved of submitting only the answers through Internet while 3% were uncommitted and the remainder did not like using email for answering assignments. Submitting both answers and calculations did not seem to be a good idea. Most of the students, 72% disapproved. In the content of receiving grades through Internet, 66% approved and liked the immediate feedback.

Specific statements concerning the submission of assignment using the Internet were:

1. Ease in submitting the assignments even after school hours.
2. Prefer to submit both answers and calculations because the Professor can easily follow the logic used to solve the problem.
3. Submitting answers though email allows for expeditious grading.
4. Since there can be differences in the estimating answers, most of the students believed it is better to submit a hard copy of the calculations after the answers had been sent through the Internet. This is mainly for objective evidence and possible partial credit.
5. When the students do an early submission of the assignment and realize that they have made a mistake the mistake cannot be fixed if the Professor grades the paper and replies immediately.
6. Difficulties in showing calculations on the Internet GGI forms. It consumes more time to type the answers than to solve some problems.

A high percentage of students, 66% fall 1996 and 85% spring 1997, favored receiving grades through email. The grades were posted in the WWW shell in the second semester and 70% liked that method.

### ***Other Opinions***

The following are additional student recommendations.

1. Make all the notes available at the beginning of the course and use an early class period to explain how to use the system and software.
2. Informing students when new data/files/homework are available on the WWW.
3. Provide free Internet/email access to the students from home computers.

4. Post the scores of the individual assignments in the WWW to allow students to compare results.
5. Place hints and help information about assignments on the web to aid the students in takeoffs and with complex assignments.
6. Hold the class in the computer lab.

### ***Instructor Evaluation***

The Instructor of the Advanced Building Estimating course evaluated the course framework at the end of each semester. The following are the instructor comments regarding the course delivery system.

1. This course delivery method forces students to work.
2. The course delivery system using the web provides the students easy access to external and internal information. There is an enormous amount of external information related to the course that can be accessed through the web.
3. It increased mentoring. The instructor did not need to discuss the basic issues in the classroom. The information related to basic course ideas can be retrieved from the web. The instructor used the classroom time for an interactive and cooperative discussion on more critical and advanced topics.
4. The most important issue was enhancing the transfer of knowledge due to web communication. The mission of serving the construction industry is enhanced due to the technical skills students will carry to industry.

## **V. CONCLUSIONS & RECOMMENDATIONS**

The integration of the latest developments in information technology into undergraduate education enables students and instructor to work closely and cohesively in many ways. It was evident from this course that requiring students to use WWW technology, increases knowledge transfer and enables the instructor to reach the students more effectively.

It is clearly evident from the student evaluations and the instructor evaluation, that this delivery system improves the transfer of knowledge compared to older models. The following are the recommendations for improving the system.

1. The students must be given the opportunity to download the lecture notes using MS PowerPoint. All the lecture notes should be made available in the WWW shell at the beginning of the semester. This will allow the students to download all the notes at once as suggested by most of the students. The lecture notes prepared entirely in

HTML format should be limited to subjects containing screen prints. An example in this course are the “Timberline Estimating Software” class periods.

2. Submitting homework assignments using the Internet facilities is a critical issue to be considered, as the evaluations showed only 50% of the class liked the idea. The majority of the students had a resistance to submitting both answers and calculations through Internet due to high time requirement for entering the information. Hence, it is recommended that this feature not be extensively used during the course. Consider using the WWW only for homework assignments having short answers.
3. The students liked the idea of receiving grades through Internet. However, the instructor must not send the grades immediately after they receive the answers as suggested by the most of the students. It is the researchers opinion that grades should be sent through emails to the individual students and not publish in the WWW shell. This is mainly to increase the students motivation to use email communication as the evaluations showed that some students never read the emails.
4. The use of the team selection procedure had good results. It was clearly evident that the structured teams had better performance than the unstructured team. Almost all the teams had scheduling problems.
5. The instructor must use a different approach when using this course delivery system to teach the class. As explained in the instructor evaluation, mentoring is the area where the instructor must concentrate. The instructor does not need to discuss the basic issues in the classroom unless the students send questions prior to the class. Instead, the instructor must use the classroom time to discuss the critical and advanced issues.
6. The students should be given a task to read the lecture notes prior to each class and send questions to the instructor that will be required discussion in the classroom.
7. Allow time during the class for the students to interact with their teams.

The students evaluations show that the application of the WWW framework for construction estimating was a success. Benefits of utilizing this delivery system include creating more student interest, providing better learning resources, improved learning quality, and enhanced student interaction.

This delivery system empowers the instructor to utilize the classroom atmosphere to transfer knowledge using mentoring on critical issues rather than spending time on basic material.

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