Developing Effective Course Websites to Supplement Traditional Classes

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Abstract

While a few courses around the country have been developed that are heavily dependent upon information technology and the internet, thousands of courses have taken a more conservative approach and chosen to augment conventional classroom instruction rather than replace it. Although a well executed and integrated website has the potential to dramatically enhance active learning, designing an effective website can be frustrating, challenging and time consuming. The goal of this effort is to identify what a course website should be designed to do, what should appear on a course website and how it should be formatted. Survey data are presented illustrating the effectiveness of two different course websites and the websites are examined to determine what characteristics led to their success or failure.

Introduction

Technology has undoubtedly changed education. Many universities have created virtual classrooms where students can remotely logon, attend online lectures, turn in electronic homework, and take online tests[1,2]. While web centered courses offer many distinct advantages, they face many challenges and are not yet ready to supplant traditional courses[3]. Courses that integrate the internet into an existing conventional classroom environment stand to significantly increase student interaction and active learning. Nevertheless, the question of what a course website should do and how it should do it is still largely unclear[4]. Furthermore, the disparity between what instructors put on websites and what students want on websites is quite large[5]. To compound matters, studies indicate that the number of courses attempting to integrate websites into the classroom is also increasing at an alarming rate[6]. Unless these issues are resolved, thousands of educators in all fields will squander valuable time developing poor websites.

When a professor finally decides to make a course website, many decisions must be made regarding content, format and layout. It seems that the default website typically has some administrative information such as a syllabus, a few outdated and rarely updated solutions, a faculty biography and some undocumented links to other sites. Further, the average website suffers from organizational problems that tend to hide the data that is present. In many cases, these websites are of little use to the student and are seldom visited. In the extreme, poorly executed websites can detract from a student's opinion of the course and can sap their motivation as they repeatedly visit the website looking for information. The result is that many professors are of the opinion that course websites are a waste of time or that they are unnecessary[5]. On the contrary, a well-executed website can be valuable educational tool that will, in a manner similar to a course textbook, become a crucial component of a student's learning.

Background

Several courses in the Civil & Mechanical Engineering Department at the United States Military Academy have recently developed supplemental course websites. In fact, out of the 13 courses offered during the spring semester, only 2 do not maintain some form of course website. Unfortunately, many of these course websites are less effective than they could be despite the best intentions of those who developed them.

Many individuals have developed criterion to help to determine the effectiveness of a course website. One study addresses a large number of issues organized into the following areas, layout, pedagogy, navigation and organization, accessibility and others[7]. While the study highlights many key issues that website developers should be aware of, it does not provide data that supports its conclusions. By and large, this seems to be the trend in most of the literature regarding website development[8 9].

For the purposes of this investigation, the effectiveness of a course website will be determined by how well it accomplishes the tasks identified in Figure 1.

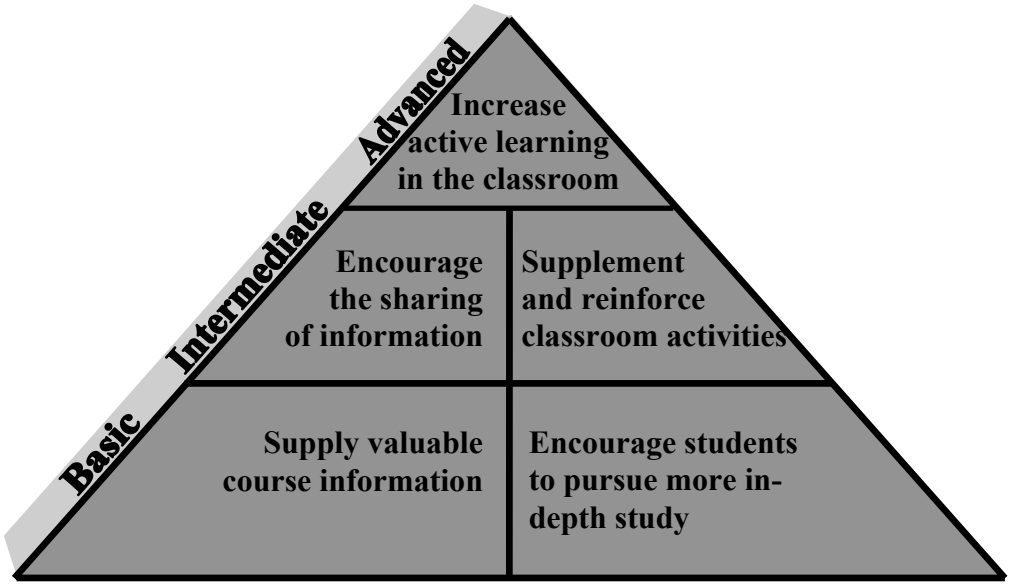

Figure 1: Hierarchy of Course Websites

As Figure 1 indicates, these tasks can also be used to classify a course website into one of three categories, basic, intermediate and advanced. Basic websites are the most plentiful and typically supply administrative information to the student. They also usually have some interesting links about related material that students can follow if they choose. Intermediate websites are less frequently encountered. In addition to performing the tasks of a basic website, an intermediate website attempts to promote communication. Communication between students and between the student and the professor can be either via asynchronous (email, or discussion groups) or synchronous (chat rooms) avenues. It also provides additional guidance to the student in the form of homework tips, refresher information, or additional practice problems that students can accomplish at their own pace. Advanced websites are a rarity. Although the name of the category implies that only the most web-savvy individuals can create these sites, such is not the case. An advanced course website enhances what is done in the classroom by influencing

what a student does to prepare for class and it enables professors to focus classroom activities on the areas where the student require assistance: these sites promote active learning in the classroom[10].

Without question, creating an advanced website requires more effort. However, the potential benefit of increasing the amount of active learning that takes place in the classroom makes this a worthy goal to strive toward. Several educators have raved about the importance of making the classroom an environment where students are active participants in class sessions[11]. Nevertheless, sometimes classes become mundane sessions where information is merely transferred from professor to student and active learning is not taking place. While there are many likely scenarios that lead to this, they typically hinge upon a shortcoming in either the student or the instructor. In the first scenario, the student fails to adequately prepare for class thereby requiring the instructor to address basic aspects of a topic before moving on to higher level learning objectives. Another likely scenario occurs when the instructor fails to adequately gauge the knowledge level of the class and plods needlessly through definitions and fact based objectives before moving on to more advanced material. While it might appear that this second scenario would result is a terrible learning experience, such classes are easier to prepare for and enable instructors to add superfluous elements that can make the lesson very engaging. Regardless of whether these information transfer lectures are engaging, Lowman points out that these sessions waste precious time and the opportunity to pursue higher-order learning objectives[12]. He goes on to state that instructors should use classes "(1) to clarify especially difficult concepts or procedures, (2) to illustrate content using engaging examples, and (3) to emphasize the connections between concepts." In support of these objectives, an advanced course website attempts to identify what *students* perceive as the especially difficult concepts, introduce the material with an engaging multimedia display, and free up additional class time so that the instructor can provide additional examples and illustrate connections between related topics. The study by Novak and Patterson, suggests that advanced websites are able to accomplish these objectives[10].

Recognizing the trends in the use of the web in education vendors such as WebCT Inc. and Blackboard Inc. have developed commercially available software packages available to assist in the generation of a course website. Nevertheless, it is unreasonable to expect instructors to be able to build and successfully integrate an advanced website into the classroom on the first iteration. The pattern of development suggested by Simione and Tuttle, recommends that a website begin by including basic functions and then progressing to more advanced features[13]. This incremental approach is supported by data that indicates that basic and intermediate websites are beneficial to a course. A study by Morss and Fleming investigated the efficacy of different tools employed by websites[14]. In general, all of the websites in the study could be classified as either basic or intermediate level websites as they employed different combinations of tools such as a discussion board, quizzes and self-tests, a calendar and a glossary. The data from this study indicate that basic and intermediate level websites are able to achieve a moderate level of success with regards to maintaining student interest the rate at which students learn material. The benefit of basic and intermediate level websites is critical because well designed and integrated advanced course websites take time to produce. Just like any other product, website maturation requires time and iteration.

Results

Two course websites were examined to determine their effectiveness. By examining the effectiveness and traits of two disparate websites, a list of guidelines will be developed to assist in the development of future course websites. The first website selected was for a course in Computer Aided Design and is highly regarded by cadets and faculty alike. The instructor who developed this site can be described as an early adopter with respect to integrating website into the classroom as he has used a variety of advanced functions for an extended period of time[5]. The second website selected was for a Fluid Mechanics course and was selected because it is representative of a typical website found in the department. Both courses are taken primarily by third year cadets majoring in Mechanical Engineering. Additionally, almost all cadets enrolled in Computer Aided Design were also enrolled in Fluid Mechanics this semester. It should also be noted that all cadets own relatively new computers and are connected to the Academy network via high-speed connections. This gives the web developer freedom to use any techniques required without fears of bandwidth problems or computer problems.

Both survey data and anecdotal evidence is used to determine the effectiveness of the course websites. Survey data was gathered at the conclusion of the semester from a large percentage of the students enrolled each course. The surveys were administered anonymously via a free online service, www.surveymonkey.com, and contained both multiple choice and open-ended questions. Anecdotal evidence in the form of informal conversations, emails and classroom examples is also presented.

To reiterate, the effectiveness of a website will be determined by how well it achieves the tasks in Figure 1. One low level task addresses supplying valuable course information. This issue deals with how receptive cadets are to obtaining course documents from a website as well as what information can be disseminated effectively. As shown in Figure 2, cadets in both courses indicated that they preferred electronic documents to their paper counterparts. These results are especially encouraging at universities where copier restrictions are enforced. However, there is a discrepancy between the two courses as a larger percentage of the cadets enrolled in the Fluid Mechanics class preferred to receive hard copy versions of the course documents. This is most likely due to the structure of the class. Most lessons use in-class worksheet problems to reinforce key concepts. This suggests that if a significant number of documents are to be distributed, and if those documents go beyond administrative information, then perhaps hard copies should be provided.

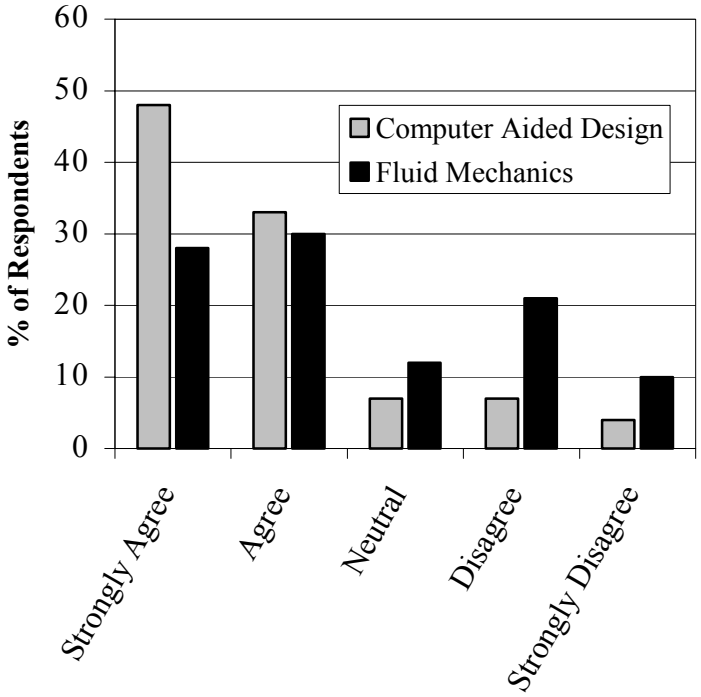

Figure 2: I prefer to receive documents online rather than in hard copy

Some of the open-ended question responses also provide more insight into this issue. Currently, the Fluid Mechanics course provides the in-class worksheets in both hard copy and online. While some students thought this to be redundant, many appreciated the ability to obtain worksheets for classes that they missed. Other students stated that they liked being able to download clean copies of the worksheet problems so that they could use them as additional study problems. Therefore, distributing some documents in both fashions is beneficial.

While distribution of course documents such as policy letters, syllabi, and worksheets is one aspect of supplying valuable course information, other information can also be published on a website. Homework assignments and design project handouts can also be more effectively placed on a website. For instance, on several occasions cadets failed to copy down routine homework assignments in the Fluid Mechanics course even though the assignments were clearly and predictably posted on a side chalkboard in the classroom. The Computer Aided Design course assigned all homework and projects via the website and students never questioned whether or not an assignment was due; they just logged on, clicked the assignments link and knew exactly what was due. Therefore, this data indicates that publishing all course information on a website is beneficial even though students still prefer to receive some documents in paper copy.

An issue related to what should be posted on a website deals with what format documents should be in when they are placed on a website. As a rule of thumb, if the students are going to print out the information, then the data should be in Portable Document Format (.pdf). Posting the files in .pdf ensures that 1) the formatting of the document will not change 2) the student will see exactly what the instructor posted and 3) all students can read the document because almost all internet users have downloaded (or can download) a free copy of Adobe Acrobat Reader. Additionally, .pdf files bring a level of security to the website. For instance, the Fluid Mechanics website posted daily reading logs that accompanied the reading assignment for the upcoming class period. If the documents were saved as Microsoft Word documents, then it would have been extremely easy for one student to download the file, type in the answers, and then forward the file to everyone in the course. Undoubtedly, a motivated student could still do the same thing with a .pdf file, but it would take at least a few more deliberate actions on their part.

Now that the issue of what information should be placed on a website and how it should be formatted has been addressed, the next logical issue is organization of that information. Again, the two course websites will be used to illustrate effective and ineffective ways to accomplish this task. The Fluid Mechanics course chose to place all administrative information such as policy letters, the syllabus, faculty biographies, and course grades under a button named "Admin". The homepage for the Fluid Mechanics website is shown in Figure 3. Additionally, the Fluid Mechanics course is divided into roughly three thirteen lesson blocks. Rather than listing all forty lessons on the home page of the website, links to each of the three blocks were offered. Students reported that they did not like this organization scheme because they were often unsure of which block of instruction they were in. Many students reported in the open ended survey questions that the organization of the Fluid Mechanics website was the worst aspect of the website and, ironically, pointed to the Computer Aided Design course as an example of an effectively organized website.

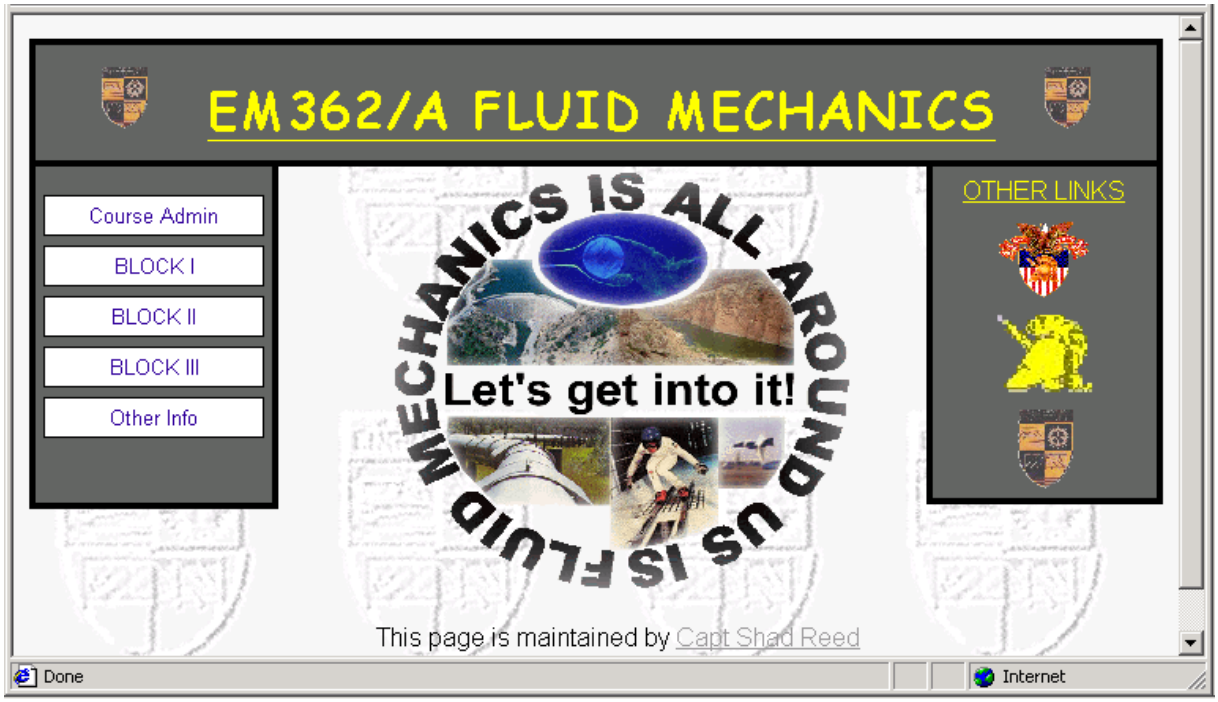

Figure 3: Fluid Mechanics Course Website Homepage

On the other hand, many reported that the Computer Aided Design was very easy to navigate in and find desired information. There are two key components of the website that contributed to this finding. The homepage of the Computer Aided Design website, shown in Figure 4, has easily identifiable links that place the information that the students desire in logical locations.

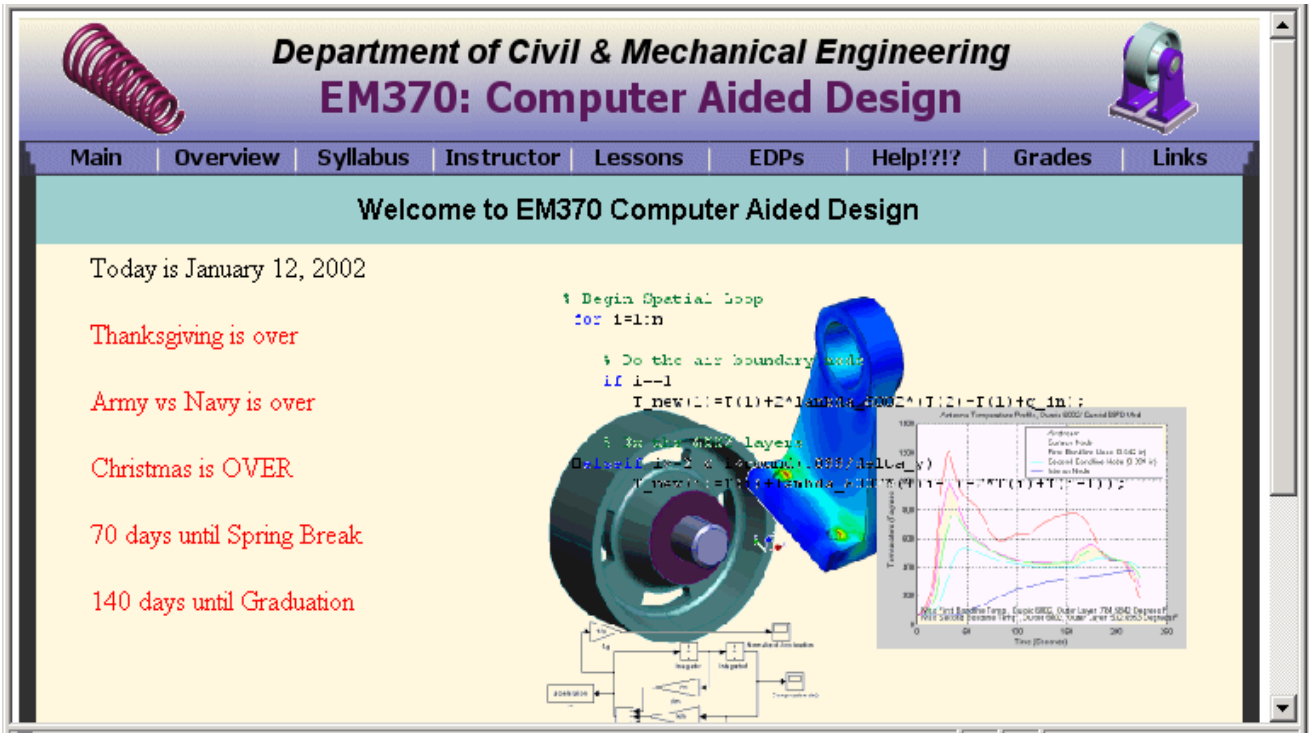

Figure 4: Computer Aided Design Website Homepage

Further, the way that the Computer Aided Design course includes its syllabus is also important. Syllabi comprised of a long table of information organized by lesson number are less effective than the syllabus that was included on this site. The Computer Aided Design websites syllabus has the following key characteristics 1) the syllabus looks like a calendar, 2) the syllabus identifies key assignment due dates, and 3) the syllabus has links that take the student to a page for each specific lesson. In short, it provides essential data (lesson topic and assignment due dates) in a familiar manner (standard calendar layout), with the option of more detailed information just a click away (active links to pages on specific lessons). An excerpt from the Computer Aided Design syllabus is shown in Figure 5.

April 2002						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
		2-24 EDP#2 Design Studio	1-24 EDP#2 Design Studio	2-25 EDP#2 IPR	1-25 EDP#2 IPR	
7	8	9	10	11	12	13
	2-26 EDP #2 Design Studio	1-26 EDP#2 Design Studio EDP #2 Due at 1600 hrs	2-27 NM#4, Curve Fitting	1-27 NM#4, Curve Fitting	2-28 NM#5, Numerical Integration	
14	15	16	17	18	19	20
	1-28 NM#5, Numerical Integration	2-29 Finite Difference Methods #1	1-29 Finite Difference Methods #1	2-30 LAB FDM#2	1-30 LAB FDM#2	FEE

Figure 5: Computer Aided Design Syllabus

The students' survey responses reinforce the notion that the website must be designed from the viewpoint of the student and that what the instructor perceives to be a logical structure may be frustrating to the student[13]. In cases where a large number of courses in a department or university maintain course websites, efforts should be taken to standardize the organization and structure of the websites so that students find themselves visiting pages that seem familiar. The added benefit of this is that the instructor is relieved from having to make these decisions.

The second measure of effectiveness from Figure 1 addresses the website's ability to encourage students to pursue more in depth study. Unfortunately, the survey question only addressed the course that the student were currently enrolled in and did not provide any insight into whether or not a student was motivated to continue more in-depth studies in the field. More in depth study encompasses learning more about a specific topic for the current course as well as learning more about a discipline through additional coursework or individual study. Although the faculty member also strives to inspire the students with class discussion, the website can do this at all times of the day or night. Typically, websites attempt to accomplish this by simply supplying a list of interesting links that can maintain the student's attention. If students find the

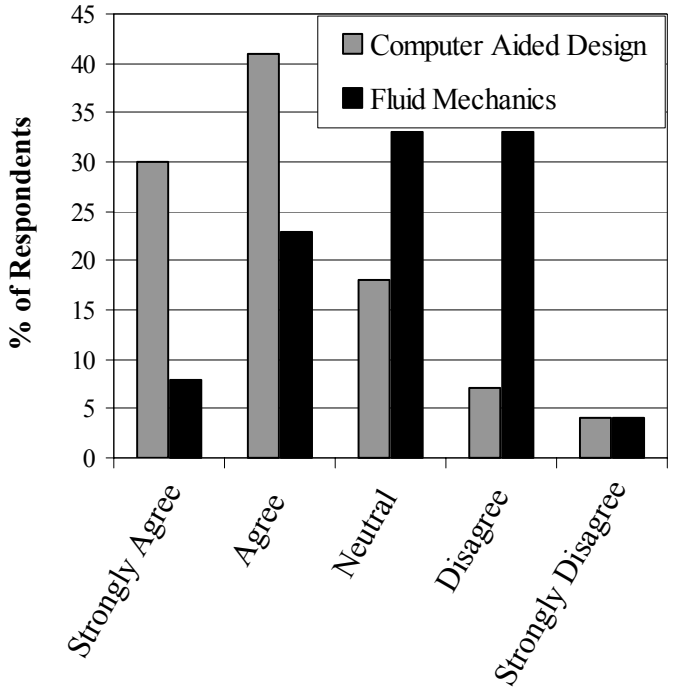

Figure 6: I was more inspired/motivated to learn in this course because of the website

links interesting or entertaining, then they are likely to spend more time thinking about the course than if the links were not present.

The survey asked students to report whether or not they were more inspired or motivated to learn in this course because of the website. Figure 6 indicates that the Computer Aided Design course website was much more successful in this area also. The most likely reason for this is that the website is a reflection of the instructor's interest in and passion for the course. A dull, uninteresting website can sap a student's motivation in the same way a dull, uninteresting lecture can. Thus, maintaining a list of interesting links is only a small part of the equation: the site must convey how excited the instructor is about the subject.

The previous two tasks, supplying valuable course information and encouraging students to pursue more in depth study, are the most basic tasks that a website should perform. In order for a website to become an intermediate level website, a website should attempt to encourage the sharing of information. This task is different from supplying course information because to be successful in this area, the website must promote communication between students and professors and between students. While the importance of student/professor communication is rather obvious, student-to-student communication is also very valuable. Many times students can learn from their classmates easier than they can from a professor.

The Fluid Mechanics website failed to display any characteristics that could promote any two-way communication. On the other hand, the Computer Aided Design website did make efforts to encourage the sharing of information. For instance, the website contained a searchable Frequently Asked Questions (FAQ) section where actual student questions where posted along with the professor's response. Although many of the questions in the section focused on how to accomplish a certain task with one of the software packages used in the course, maintaining a FAQ will allow students to learn from the trials of others.

The Computer Aided Design course website did not maintain a formal chat room or discussion group. The instructor instead decided to employ a tool that had most of the functionality of a chat room with significantly less effort. The instructor signed up for an instant messenger service. An instant messenger program runs in the background of a computer and monitors who is logged onto a certain network. Popular programs such as America Online Instant Messenger (AIM), Yahoo Messenger, MSN Messenger, and ICQ allow to users who are logged on, to communicate in real time with one another. An added incentive for implementing the instant messenger approach is that students can reach the instructor anytime that he is logged

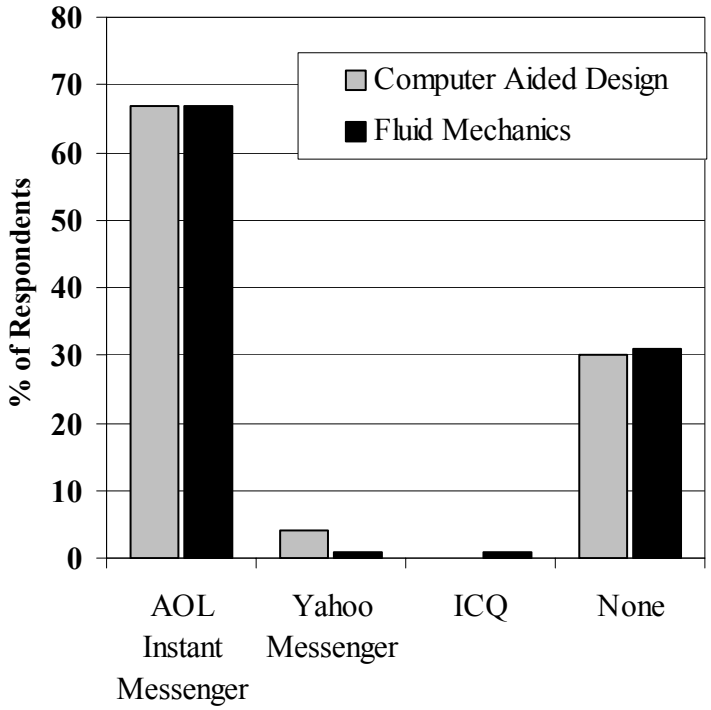

Figure 7: Would you contact your professor on an Instant Messenger?

on, even when the instructor is logged on at home. If the instructor had chosen to implement a chat room or a discussion group, then he would only be able to communicate with students when he is logged onto a computer on the Academy's computer network. Additionally many students already familiar with these programs and use them to communicate with friends and family. As indicated in Figure 7, students would like to communicate with professors this way also.

The data clearly indicate that students would prefer to correspond with their professor via an instant messenger by a 2 to 1 margin. One explanation is that communication via an Instant Messenger is, without question, more convenient for the student. Additionally, communication via an Instant Messenger is perceived to be less formal and daunting than visiting a professor's office or even calling them on the telephone. Some critics might label this type of communication as too informal or too easy, but many times student's questions go unanswered because they are hesitant to ask questions face to face. Obviously, not all questions can be answered on an Instant Messenger, but in most cases, the professor can quickly identify who needs to come in for additional instruction and who merely needs a quick pointer. The Computer Aided Design professor experimented with communication via Instant Messenger during the semester with very positive responses from the students.

The next intemediate task that a course website should accomplish is to supplement and reinforce classroom activities. One way that this can be accomplished is through the use of tutorials. Tutorials were placed on the Computer Aided Design website to help guide a student through a task just as a professor might if present. Tutorials such as these definitely helped to reinforce skills that were learned in class. Providing more advanced tutorials supplements skills that were not taught in class.

On line tutorials are not the only manner in which websites can supplement or reinforce classroom activities. Another way that websites can reinforce classroom activities is by offering a list of recommended problems and solutions. The Fluid Mechanics course website had links to over one hundred recommended problems from the textbook and their solutions. Almost sixty percent of the cadets cited these problems as the most valuable component of the Fluid Mechanics website.

Additionally, because there is often not enough time in class to address some material completely, websites can be used to expound upon the information in the course text and provide

supplemental information. For instance, showing a complete derivation of a particularly involved equation may not be the best use of classroom time in a certain lesson. The complete derivation, to include steps omitted in the course textbook, can be placed on the website for students who are inclined to view it. Similarly, referring students who have forgotten how to perform a certain complex mathematical operation to a page on the website will undoubtedly be more effective than simply telling a student to review their notes from a previous class. This is a feature that the Fluid Mechanics course intends to take advantage of in the upcoming semester.

The final, and most difficult, task that a website should strive to achieve is to increase active learning in the classroom. To reiterate, active learning in the classroom takes place when students are able to actively participate in the class. Participation can occur in many ways. For example, asking probing questions, contributing to class discussions, and even active *listening* are all examples of the type of participation that occurs when active learning is taking place[11]. The primary way that a website is able to influence what happens in the classroom, is by influencing how students prepare for class. The survey asked students to identify the most important feature of the website in an attempt to capture how the cadets actually used the websites. Figure 8 indicates that, as previously noted, most cadets went to the Fluid Mechanics website to get solutions to homework problems after they had been turned in, perhaps when they were studying for an exam. In a sense, the website was consulted at the very tail end of the learning cycle. This is in stark contrast to what the students in the Computer Aided Design course identified as the most important aspect of the website. These students found daily class preparation to be the most important aspect of the website followed by help on assignments. The Computer Aided Design website incorporated several activities to encourage preparation for class such as tying lesson objectives to reading and homework assignments. The homework assignments were then linked to tutorials and FAQs that guided the student through the learning process. This resulted in students being well prepared for each class and able to focus their time on the important areas of the subject material.

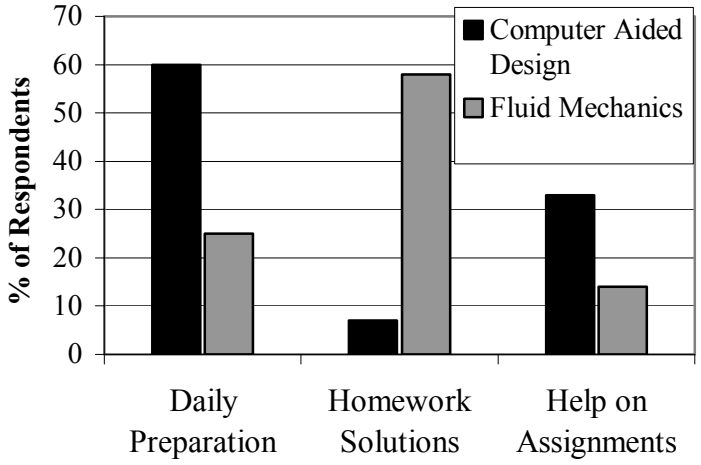

Figure 8: The most important aspect of the website

Increasing student participation by improving the level of student preparation was not the only way that the web site attempted to increase active learning in the classroom. The website also included links to daily surveys that students had to fill out prior to coming to class that would reveal to the instructor exactly what parts of the lesson to focus on. This concept is not unprecedented and has been referred to as "just in time teaching". Novak and Patterson successfully used data gathered by a course website to help shape what was taught in an introductory Physics course[10]. The study indicates that there are several benefits of this approach such as decreased withdrawal rates, improved grades, and an improved opinion of the course. In short, "just in time teaching" has merit.

The issue of whether producing a course website is a worthwhile expenditure of an instructor's time has not been specifically addressed. In one study at Northern Michigan University, a number of instructors were asked to identify the primary reason that they did not have a course website. The study reports that 43% of the respondents felt that their teaching style was effective and that they were not inclined to change it. Another 16% of the respondents stated that there simply was not enough time to develop a website[5]. In an attempt to illustrate the value of a website, students were asked whether the website was crucial to learning the required course material. As Figure 9 emphatically illustrates, an advanced course website such as the Computer Aided Design website can play a critical role in the learning process. An unbelievable 89% of the students, 25 out of 28, felt strongly that the course website played an important role in learning course material. In contrast, this data also suggest that the Fluid Mechanics course website played a much smaller part in the student learning the course material.

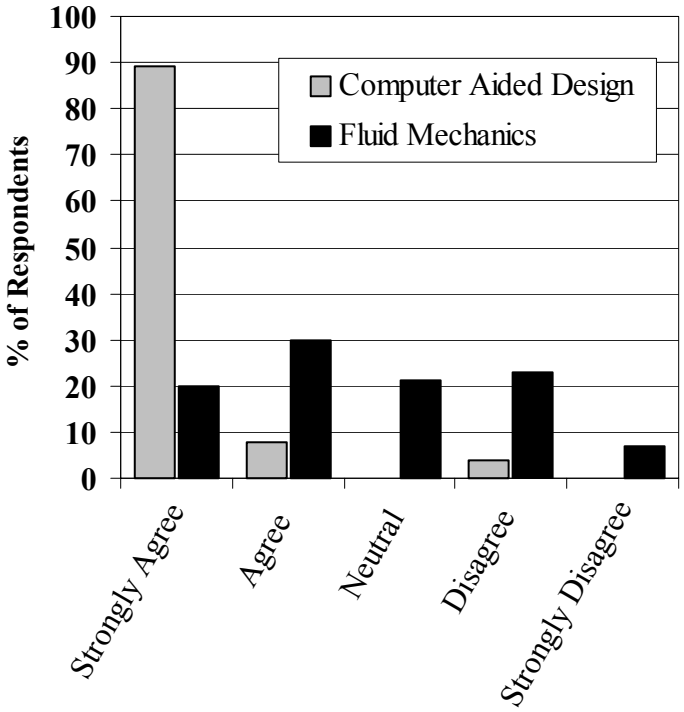

Figure 9: The course's website was crucial for learning the required material

In spite of these findings, the matter of whether website development was worthwhile is still in question. To unequivocally answer this question, additional studies similar to those performed by Poindexter and Allen must be performed to assess whether students learn more when a website is integrated into the classroom. Finally critics may question whether the Computer Aided Design course website actually played too large a part in the class. It should be noted that the website was not designed to do the instructor's job: it was designed to help the instructor do his job better.

Conclusions

Despite an increasing volume of information on the subject, instructors are still unsure of how to develop an effective course website. This study has developed criterion that can be used to classify websites into three stages, basic, intermediate and advanced. This criterion is based on sound pedagogical theory and can also be used to determine the effectiveness of a website. The data suggest that basic websites have a limited value whereas advanced websites can play a crucial role in the learning process. Future studies will focus on attempting to quantify the effect of these types of websites on how much students learn. Additionally, because the statistical significance of these claims has not been investigated, more controlled studies will be conducted.

[1] Strong, R.W., and E.G. Harmon, "Online Graduate Degrees: A Review of Three Internet-based Master's Degree Offerings." American Journal of Distance Education, vol. 11, no.2, 1997, pp.58-70.
[2] Whittington, C.D., and Sclater, N., "Building and Testing a Virtual University." Computers Education, vol.30, nos. 1, 2, 1998, pp. 41-47.
[3] Dutton, J., Dutton, M., and Perry, J., "Do Online Students Perform as Well as Lecture Students?" Journal of Engineering Education, Jan 2001.
[4] McManus, T., "Delivering Instruction on the World Wide Web." 10 Jan 1996. http://www.svsu.edu/~mcmanus/papers/wbi.html (10 Jan 02).
[5] Poindexter, S. and Ferrarini, T. "Web Integration in Courses: Which Factors Significantly Motivate Faculty." Stop Surfing/Start Teaching National Conference, Myrtle Beach, SC., February 1999.
[6] Poindexter, S. and Ferrarini, T. "Does Student Internet Pressure + Advances in Technology = Faculty Internet Integration?" IACIS Annual Conference, Vancouver, British Columbia, Canada, October 2001.
[7] Khan, B. and Vega, R., "Factors to Consider When Evaluating a Web-based Instruction Course: A Survey." In B. Khan (Ed) Web-based Instruction. New Jersey: Educational Technologies Publications.
[8] Embleton, K., "Online Teaching Tips." 3 Dec 1999. http://www.fcs.iastate.edu/computer/faq/tips/onlinetechtips.html (10 Jan 02).
[9] Girma, D., "Teaching Assistant Portal – A Web-Based Tool for Enhancing Teaching and Learning of Lecture-Based Modules." North American Web Conference, Fredericton, New Brunswick, Canada, October 2000.
[10] Novak, G. and Patterson, E., "Just-in-Time Teaching: Active Learner Pedagogy with WWW," IASTED International Conference on Computers and Advanced Technology in Education, May 1998.
[11] Evans, M. "Teaching Lessons Learned." Journal of Professional Issues in Engineering Education and Practice, Oct. 2000, pp.138-141.
[12] Lowman, J. Mastering the Techniques of Teaching. San Frnacisco: Jossey-Bass, 1995.
[13] Simione, A., and Tuttle, J., "Designing and Implementing College-Wide Web-based Course Materials: A Case Study." North American Web Conference, Fredericton, New Brunswick, Canada, October 1997.
[14] Morss, D., and Fleming, P., "WebCT in the Classroom: A Student View" North American Web Conference, Fredericton, New Brunswick, Canada, October 1998.