GETTING HELP FROM COURSE MANAGEMENT SOFTWARE TO TEACH A LARGE–ENROLLMENT INTRODUCTORY GEOLOGY CLASS

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ABSTRACT

Course management software allows instructors to introduce an Internet-based component to their classroom teaching even without any prior knowledge of HTML language. I used one of the most widely available software, WebCT, for two introductory geology classes of approximately 250 students each at Iowa State University in fall 2001. The software is easy to use and I established a variety of content and communication tools in less than a day, using the procedure described in the paper. Student responses to the use of WebCT were in general positive and they especially liked the opportunity to communicate with me, to keep track of their assignments with the "Calendar" tool, and to view their grades online. Students who earned good grades in the class are also the ones that made more extensive use of WebCT, especially with the "Discussion" tool. However, it cannot yet be demonstrated that the use of WebCT helps learning in a measurable way.

Keywords: Education – Computer assisted; Education – Undergraduate; Geology (general)

INTRODUCTION

Much is being written about the use of technology as a teaching and learning tool (e.g., Mantei, 2000; Durbin, 2002). However, most of the focus is on distance learning, computer simulations, and the use of the WWW as a communication tool. This article deals with utilizing the Internet as a medium for empowering learning and course management of on-campus classes using the enterprise-wide software system WebCT, which has proven to be very useful in managing a large introductory geology class. The article also gives a simple tutorial on how to create an Internet-enhanced course in less than a day using WebCT and with no prior knowledge of HTML language or FTP procedures.

Software companies and educators have been exploring ways to use technology to exploit distance learning or in the classroom. Packages vary from more or less sophisticated gradebooks (e.g., Gradebook 2, www.gradebook.com), to powerful tools for merging curriculum and instruction (e.g., 4Mation, www.about-learning.com), to online assessment programs (e.g., Test Pilot, www.clearlearning.com). However, most of these packages are designed to do one specific job and do not provide an integrated classroom experience. Class management software such as Blackboard (www.blackboard.com), TopClass® (www.wbtsystems.com), and WebCT™ (www.webct.com) were conceived to transform the Internet into a powerful environment for teaching and learning, providing easy-to-use software to faculty.

Achieving good communication between teacher and students is one of the fundamental goals of 'good teaching' and it has been shown to improve learning (Shymansky and Penick, 1981). However, to establish two-way communication with all the students in a large lecture setting is practically impossible using only traditional methods. Computer technology and course management tools provide the students and the instructor with a practical means to communicate and exchange information (e.g., McKeachie, 2002).

In 1998 Iowa State University (ISU) acquired licenses for WebCT and TopClass (P.L. Spike, internal communication). During the first year, the response of instructors who used these systems indicated that they found WebCT easier to administer. ISU has now a site license for WebCT together with 1570 other institutions in the U.S. and nearly 1000 institutions in 80 countries (WebCT is available in 10 languages) (www.webct.com, data as of January 18, 2002). In addition, ISU supports a locally developed class management system, ClassNet (http://classnet.cc.iastate.edu/cgi-bin/main-menu, Van Gorp and Boysen, 1996). Blackboard is the commercial alternative to WebCT that covers an equally large share of the market. Since ISU has a site license for WebCT, this is the course management software that I am describing in this paper and that I have used for this study. However, the results of the impact of WebCT use on course teaching and student learning can be extended to any course management tool.

In the rapidly evolving world of electronic learning, posting a syllabus and a course schedule online is no longer sufficient (Harmon and Jones, 1999) and students often expect that at least some part of their courses utilize the Internet. On the other hand, it is unrealistic to expect that instructors and scientists be proficient in HTML. In the fall 2001 I taught two sections of Geology 100 – The Earth - at Iowa State University, with a total enrollment of 483 students. My goal for this class was to design a learner-oriented environment (e.g., McManus, 2001). However, I quickly realized that using the Internet to administer grades and assignments was an unavoidable requirement, so I enrolled in a crash course on WebCT offered by ISU's Instructional Technology Center that in three hours gave me sufficient hands-on experience to set up the class page. In this article I share my learning experience, guide potential users through the steps required to set up a course in WebCT (Friesen, 2001), present the results of my students' learning experience, and discuss the results I have obtained.

WHAT IS WebCT?

WebCT is a course management software created by Murray Goldberg, of the computer science faculty at the University of British Columbia. WebCT's goal is to provide instructors with an easy-to-use course and content management tool as well as various assessment tools aimed to facilitate online communication, deliver course content, and provide a variety of ways for student evaluations while keeping students informed of their grades and progress (www.webct.com). Since 1998, when it was first introduced to Iowa State University, WebCT's use has increased exponentially. Data compiled by G. M. Yang in spring 2002 (Instructional Technology Center, ISU, https://webct.ait.iastate.edu

/ISUtools/webhtml/designer/stats.html) show that the numbers of both courses and students enrolled in WebCT courses have tripled in the last year, in line with a trend experienced by most campuses that have adopted course management software. There are currently 516 WebCT course accounts at ISU, of which 310 are active (of a total of 5580 courses offered between summer 2001 and spring 2002). At ISU, 14,914 of the 27,823 students registered in 2002 are enrolled in one or more WebCT courses. WebCT 3.6 is the version currently in use at Iowa State University.

To access any course content within a WebCT class site, users (students, teaching assistants, instructors) are required to authenticate to the system using a login name and password. This creates a protected environment that students can access from home, computer labs, libraries, and Internet cafés, which is designed to allow open communication and exchange of information and data among students and instructors.

GETTING STARTED

WebCT accounts for classes are set up by a WebCT systems administrator, which is typically affiliated with the college or university's Instructional Technology Center or computing group. Typically the completion of an on-line account request is sufficient to register a course. Information about the course includes course name, course title, and category (e.g., college affiliation). The instructor can choose among a blank WebCT template, a default WebCT template (with the most popular functions ready to be modified), or a new WebCT course based on an existing course template. The latter option allows a new WebCT course to be created duplicating an existing course, which can be used for multiple course sections that require the same content. The enrollment options used to add students to a WebCT course provide a wide range of flexibility. ISU's Instructional Technology Center customized WebCT to create a 'Course Mapping' enrollment option that would work with the ISU Registrar's Program. With this option, students who are officially enrolled in the class are automatically added to WebCT. The link with the Registrar's office at ISU also allows a daily update of the class list (adding or adding/deleting students as they were added or dropped from the class list) after the initial enrollment. This feature is particularly useful for large classes and is now available as a standard in WebCT Campus v. 3.7 together with the possibility to report grades directly to the Registrar's Office, changing WebCT from a simple course management software to an enterprise-wide system. In the WebCT system available at ISU, students can also be manually added, either individually or by uploading a list of students from a word processor or spreadsheet file. In addition, students can also enroll themselves. Students are entered with their first name, last name, and user ID.

If the student is automatically enrolled on the course's WebCT account, all he/she will need to do is to log in on the institution's WebCT page. The class or classes the student is currently enrolled in will appear on a list upon login. Below the class name, there will be a list of new items highlighted in green that will allow the student to access directly any item that changed in the site since he/she last logged in.

WebCT's page looks like a regular WWW page with frames. At the top of the page there is a Menu Bar that allows the student to log out, to return to the opening page (MyWebCT) where all the WebCT-enhanced courses the student is enrolled in are listed, and to access a useful location-sensitive Help item. To the left of the page, a Control Panel allows the course designer to manage the course, files, students, and add a page or a tool. Below is the Course Menu, a list of the items accessible to the students. The main, central part of the page is the Content Area. A 'Breadcrumb' is accessible on top of the Content Area and allows tracking of the various items that have been accessed in the order they were accessed, with the most recent, active one furthest to the right. Above the Breadcrumb, the instructor has the option to toggle between the View and the Instructor Design options. The View option shows the items that will be viewed by students, the Instructor Design option allows the instructor to easily create and modify the WebCT page.

To begin, let us assume that we have chosen a blank WebCT template for the course. Under Manage Course (Control Panel), one can add one or more Teaching Assistants (TAs) to the course by entering their login ID. The ID is automatically matched with the institution's email directory and Last Name and First Name entered in the appropriate columns. TAs have access to all tools like the students but have also limited instructor privileges that allow them to edit the "Gradebook". They are, however, not course designers and cannot, therefore, modify the tools or the page.

Next, one can populate the WWW page with various items or tools. WebCT provides a series of tools to choose from. Tools are grouped into five categories:

1. Communications: Mail, Discussions, Chat, Whiteboard
2. Course content: Content Module, Syllabus, Glossary, Search, Image database, Calendar, Index, CD-ROM, Compile, Resume Course
3. Pages/URLs: Organizer page, URL, Single page
4. Evaluation Tools: Quiz/Survey, Self Test, My Grades, Assignments.
5. Study Tools: My Progress, Language, Student Presentations, Student Homepage, Student Tips.
   For Geology 100, I selected the following tools:

- Organizer page
- Syllabus
- Content module
- Calendar
- Mail
- Discussions
- Chat
- Survey
- My Grades
- Student tips

Operations on WebCT are done by selection (click on the radio button next to an item among a selection) and by choosing the action with buttons. The Organizer page is a folder that contains one or more tools. I used one for Communications (containing "Discussions", "Mail", and "Chat") and one for Course Notes (containing one "Content Module" for each file of notes).

To add a tool, one chooses the option 'Add Tool' from the Control Panel for Designers to the left. A page with the various tools appears and the chosen item is selected by clicking on its radio button. Clicking 'Add' opens a new page that allows one to enter the title of the

page, its location (on the Navigation bar, visible on all pages, or on an Organizer page - a scrollbar lists the Homepage or any other page that one has previously created), and its appearance (as title and /or one of the default icons chosen by WebCT for that particular tool). Clicking 'Add' creates the tool.

COMMUNICATION TOOLS

Each tool can be customized and modified. The Discussion tool is a Bulletin Board and by default it contains three topics: 'All', 'Main' and 'Notes'. Additional topics can be added by choosing "Manage Topics" from the "Designer Option". It is important to remember that WebCT requires one to click 'Go' to confirm any action that has been chosen, in this case 'Add a Topic', 'Rename a topic' or 'Delete a Topic'. By default, the settings for the topics are 'public', but individual topics can be made 'private', 'anonymous' or 'locked'. 'Update' must be clicked to confirm the chosen settings. Students choose 'Compose Discussion Message' to submit a posting. They can type the message, select in which topic they would like to post it, and even attach a file to it. Once the message is posted, it can be viewed by anybody enrolled in the class, and students or instructor can reply directly to the message from the window of the message, thereby creating a thread between the original message and the reply.

The Chat tool allows students to converse electronically in real-time with other members of the class or other WebCT courses. Four meeting rooms are assigned to each WebCT course and their names and appearance can be modified under the Designer Option. Logs for each room can be viewed by the instructor and downloaded as ASCII files.

Email messages can be sent to individual or multiple students using the Mail tool. This tool is particularly useful for communicating, for example, class cancellations or other class information to all the students without the tedious and time-consuming process of creating a class email list in one's email software address book. A separate class email list would need to be updated regularly, but, since the student list on WebCT can be updated daily from the Registrar's official class list, there is no need to keep track manually of which students are currently enrolled.

COURSE CONTENT TOOLS

The Calendar tool can be used to post homework assignments, reading assignments, and reminders of assignment due dates. The Calendar settings allow the instructor to determine if student entries are public or private (thereby making the tool a useful electronic substitute for each student's academic calendar). The Default Instructor access can be automatically set to public, allowing all students to view the instructor's postings on the Calendar. Multiple entries can be made for each date and each entry can be 'hyperlinked' to an external WWW site. This site will be accessed in a new window that will automatically open in the foreground.

The Syllabus and the Content Modules are added using the 'Add Page or Tool' option in the Control Panel. These tools are intended to contain files that have been previously created with word processing software, like MS Word™, or presentation software like MS PowerPoint™. In both cases, the files must be saved in HTML language, an option that is available in the more recent software. In the case of a single word-processing file, one html file will be created. In the case of a presentation, a folder containing multiple files for images and text files as well as an index file will be created. Selecting 'Manage Files' in the Control Panel allows one to upload the files. Since each file must be uploaded individually, in the case of presentation folders containing multiple files, the files can be compressed ('zipped') into one individual file that can then be expanded ('unzipped') within WebCT. This can be done with shareware zip programs: WinZip for PCs (downloadable from www.winzip.com) and ZipIt for Macintosh computers (downloadable from www.maczipit.com).

Within the 'Manage file' option, one can create folders to organize files and upload, edit, rename, move, delete, zip, and unzip individual files. Once the file/files have been uploaded and eventually unzipped, they can be added to the Content Module created previously by choosing the 'Modify content to this module option'. To add the file to the module, the radio button next to 'Add file' must be selected and 'Go' clicked. The file can be chosen from the list of files and folders currently available within WebCT. In the case of a presentation with multiple files, the 'index.html' file must be selected. This will automatically upload the complete presentation into the selected Content Module. The Content Module can be renamed, edited, or reorganized. When this is done, it will be necessary to click 'Update Student View' (top right) to make it visible to the students. This feature allows one to work on content without having it automatically viewable by the students.

EVALUATION TOOLS

The Quiz and Survey tool can be used to assess student progress in content knowledge or for exam practice with online quizzes. Alternatively, it can be used to get anonymous feedback from students. This is probably the most complex tool to establish among the ones that I chose. It requires creation of a question database that contains individual questions that can be selected by the instructor or randomly picked by WebCT, and presented to the students. There are five possible question types: multiple choice, matching, calculated, short answer, and paragraph. The advantage of this tool is that answers to multiple choice, matching and calculated questions are automatically graded or statistically analyzed. The disadvantage lies in the time-consuming task of establishing a question database. This can be relatively simple for survey questions, but the time required for creating a substantial number of study questions is probably more than what an instructor would like to invest. Some textbook publishers supply question databases in electronic format that can be directly uploaded into WebCT. This option was not available for the textbook I adopted for Geology 100, so I limited my use of this tool to the function of Survey.

Under the "Quiz/Survey" tool and in Designer Options, one selects "Question Database". Under this option, one can 'Add a category' (a folder for questions) or 'Add new questions to database'. After having selected the question type from the five available types and its category, the question can be typed in a text box, the possible answers entered and the correct answer identified. Once the question database is complete, one can select questions for a quiz or survey. Finally, access to the quiz or survey is controlled under 'Management' by
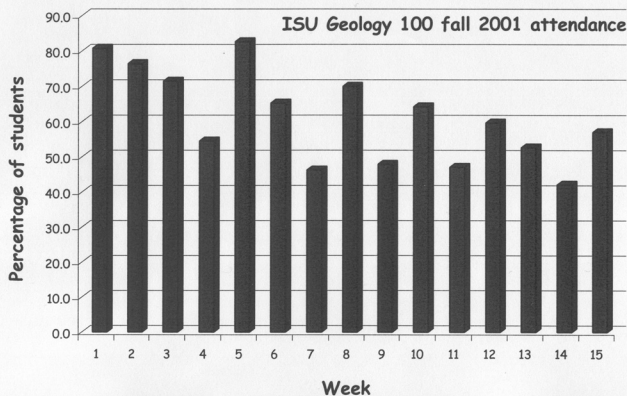
Figure 1. Percentage of Geology 100 students present in class during each of the 15 weeks of fall semester 2001. Attendance data are based on the number of in-class assignments that were turned in. In-class assignments were usually given on Wednesdays when attendance is usually highest. Attendance on Mondays and Fridays is usually lower that what shown in the graph. The average attendance through the semester was 61%.

defining the time interval during which the quiz/survey will be accessible and if the students are allowed multiple tries. Under the same option, one can view the results of the survey as scores or using a variety of statistical and graphing tools, and download them as ASCII files.

The My Grades tool is, in my opinion, the most useful tool provided by WebCT. It allows the instructor and TAs to enter student grades and points for individual assignments (individually or from spreadsheet files), to calculate sums or averages, and to assign letter grades. It allows students to keep track of their progress in class and to view the class grade distribution by using the Graph option. The 'Grades' icon that appears in the Content Area is only accessible to the individual student. The instructor and the TAs can access the complete grade book for the class under the Manage Course option in the Control Panel. By selecting 'Manage Students', the grade book is displayed. Under this option, one can add or modify columns for the individual assignments, and set up the column options (numerical, letter, calculated), as well as enter individual grades for each student. In addition, under the 'Graph' option, the results for each assignments are analyzed statistically, and the total number of entries, mean, median, mode, maximum and minimum values displayed, and a histogram of the grade distribution are provided.

STUDY TOOLS

The instructor can use the Tips tool to remind students of an assignment, an upcoming test, or to bring an interesting article or WWW site to their attention. The 'tip of the day' pops up in a separate window as soon as the student logs in and it is, therefore, a useful way to attract his/her attention. Tips are added by the instructor under Instructor Options, 'Add a new tip' in a text box.

Under the same option, tips can be edited, imported from files, or deleted.

It took me less than half a day to set up these basic tools within a WebCT page. Class notes, assignments, and grades can be continuously updated and added during the progress of the class. When the class is completed, most files and data can be downloaded and saved. The only notable exception is the record of the access and use of each WebCT tool and page by the individual student that is available under 'Manage Course', 'Track Students'. To protect student privacy, this can be viewed but not downloaded.

STUDENT USE OF WebCT

Student WebCT data for Geology 100 at ISU for fall semester, 2001 is based on 483 students. WebCT was used in this course to give students access to class notes, homework assignments, Internet-based resources, their grades, as well as to provide a forum for discussion with the instructor and among students. The textbook and my lectures were the only other learning resources provided to the students in this class. Although one can require the use of classroom resources like the textbook from students, it is ultimately up to the students to make use of them or not, and some of them choose not to. Data on WebCT use showed that 94% of the students used WebCT at least once (455 students). In the classroom I attempted to establish a learner-oriented environment with the help of hands-on activities and group discussions on topics intended to engage students in the learning of science in general. I used WebCT to assist me in reaching this goal outside the classroom and as the main vehicle to distribute information, to supplement (or in some cases, replace) content information that could be obtained from the textbook or in class, and to establish a com- munication environment. Occasionally students talked with me after class, visited me in my office, called me on the phone, or sent me personal emails. But the amount of one-on-one contact (with the exception of email) was limited. WebCT allowed me to establish a two-way communication with the students that otherwise would have not been possible.

Since WebCT was the main means for students to learn about the subject (through my notes), to access homework assignments (through the calendar), and to ask questions, especially if they did not attend class or did not purchase the textbook, I am using data on WebCT use to evaluate the impact of WebCT use on students' learning. These data include number of logins and number of discussion postings read and submitted. Data on weekly attendance (based on in-class assignments given usually on Wednesday when attendance is highest) show that on average 40% of the students enrolled in the class did not attend the lectures and that attendance declined gradually after the first week of classes (Figure 1). This indicates that WebCT and the textbook were the only learning resource available to a large percentage of the students, and WebCT and email were the only means that they had to communicate with their peers and me.

The total number of WebCT hits per student for the whole semester varied between 0 and 1600, with an average of 158 (standard deviation = 193)(Table 1).

There is a significant correlation between final grade and average number of logins (linear regression analysis, p-value < 0.0001), with the A students showing the highest average. WebCT provides a summary of the total

Final grade	Number of students	Average number of logins	Standard deviation
A	81	246	275
B	85	194	181
C	145	161	179
D	77	134	165
F	45	85	120
Dropped	50	45	64
Total/Averages	**483**	**158**	**193**

Table 1. Average number of WebCT hits by final grade. Students that dropped the class before the final exam but were enrolled in the class for most of the duration of the semester are grouped in the 'Dropped' category. This category does not, therefore, cover the full semester like the groups of students that completed the course. Note the correlation between the final grade and the average number of logins. However, the standard deviation is larger than the average in all but one category.
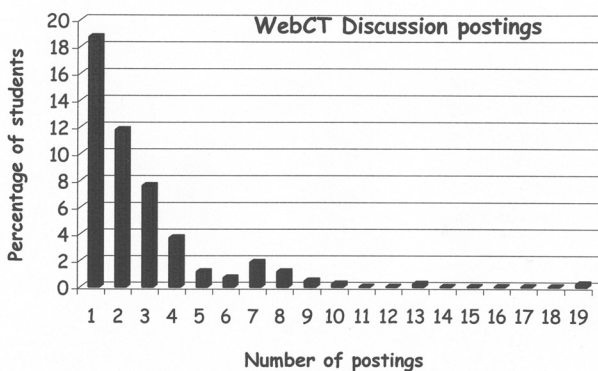

Figure 2. Frequency distribution of WebCT items posted by Geology 100 students. The number of students that posted the items is expressed as a percentage of the whole class. More than 40% of the students posted between one and four items.

number of discussion postings viewed by each student and the total number of postings that the student made. The range of viewed posting varies from 0 to 888 (the total number of discussion postings accumulated during the semester), and is heavily skewed towards a low number of postings read, with an average of 66 postings per students (standard deviation = 133). Eighty percent of the students viewed a maximum of 100 postings, 11% between 100 and 200 postings, and the remaining 9% between 200 and 888 postings. Three students read all 888 postings. It is notable that the students who earned A in the class are also the ones who made most use of the Discussion postings (Table 2). A linear regression analysis shows a significant correlation between the three parameters that indicate WebCT use (number of logins, number of Discussion items read, and number of

Discussion items posted) and the final grade earned by the student, with a p-value of less than 0.0001.

Forty-five percent of the students (218 out of 483) posted one or more (the maximum was 19) Discussion messages (Figure 2). Of the 888 messages posted throughout the semester, 352 (40%) were related to topics discussed in class. Sixty-two of these messages (18%) contained questions or geologically related information found on the WWW or in the news that went beyond a simple clarification of what we discussed in class. The 35 students that posted these messages were rewarded with one extra credit point for each posting – between 1 and a maximum of 5. One hundred and eighty-nine messages (21%) of the total messages were related to assignments, exams, scores, or logistics and did not pertain to the class material. My answers to the students' messages made up the remaining 347 messages (39%).

Since this was the first time I taught a class of this size, I do not have any data on student learning in a traditional, non-WebCT-enhanced course to compare these data. Comparing grade distribution data from the same class taught by different instructors would introduce too many unknown variables to make a valid comparison.

STUDENTS' EVALUATION OF THE USE OF WebCT

I used a WebCT-administered survey to assess the students' attitude towards Internet-based learning, at least to the extent provided by WebCT, and to WebCT in general. About two months into the semester, I used the "Survey" tool to obtain feedback from the students on the class in general and specifically on their experience with WebCT. The survey was interactive and done outside the regular class period.

One hundred and twenty-eight students (26% of the students enrolled in the class) took the survey, a low number compared to the otherwise intensive use of WebCT that most of them made during the semester. WebCT is set up to protect the student's anonymity during the survey. The students who answered the survey were among those that attended class regularly (79% said that they attended class "almost always", an additional 18% attended at least 75% of the time). When

Final grade	Number of students	Average number of Discussion postings read	Standard Deviation	Average number of Discussion message posted	Standard Deviation
A	81	131	207	1.9	2.8
B	85	82	113	1.7	2.4
C	145	54	104	1.0	1.5
D	77	47	110	1.0	2.1
F	45	44	146	0.2	0.6
Dropped	50	16	28	0.4	0.8
Total	**483**	66	133	1.2	2.0

Table 2. Average number of Discussion postings read and posted by final grade. Students who dropped the class before the final exam but were enrolled in the class for most of the duration of the semester are grouped in the 'Dropped' category. This category does not, therefore, cover the full semester. The correlation between final grade and number of postings read or written is similar to the one seen for the general number of hits per student.

WebCT tool	Number of students
Calendar	70
Discussion	41
Chat	8
Course notes	77
Grades	69

Table 3. Students' preference for the five main WebCT tools available for Geology 100. Students were allowed to give multiple answers (N=128).

asked if they were glad that I used WebCT for the class, 122 students (95%) agreed (50 of them agreed strongly). When asked if WebCT was helping them learn geology, 25% answered that it didn't help, while the remaining 75% found that it helped them some (55%) or a lot (20%). At the question, which WebCT tool they found most useful, the majority found the "Calendar", the Course notes and the "Gradebook" particularly useful (Table 3). The "Chat" tool was the least liked tool.

Fifty-two students said that they posted one or more geological question on WebCT. Based on the final records shown by WebCT, the number of geological questions posted increased towards the end of the semester, and specifically in correspondence with the class debates that were posted on WebCT late in the semester. Seventy-four students (58%) said they checked the answer to their posting (31% sometime, 27% always). I believe that the 42% who answered 'never' include the students who never posted a question on WebCT. On the other hand, close to 87% admitted to have read one or more postings made by their peers (35% of them, many to all of them). Seventy percent of the students found that reading Discussion postings helped them at least some in their learning of geology. Finally, more than 95% liked having their grades posted on WebCT.

WebCT's ADVANTAGES

The success of Internet-based communication in this course is shown by the fact that 455 students in my class (94%) made use of WebCT at least once, a very high number if one considers that some students are still uncomfortable with computers, contrary to what many of us may believe.

The "Syllabus", "Calendar", "Student Tips", and "Course Content" modules represent a simple way for the instructor to make information available to students in an easily accessible way. However, these tools do not differ substantially from a traditional WWW page where the instructor posts information related to the class. What makes WebCT and similar class management software unique, is the combination of tools within one software, and the ease with which these tools can be customized and used. Bulletin boards and chat rooms (in WebCT these are grouped under the Communication tools) can be set up for the class with extreme ease, and course notes and assignments made available without special computing skills. In particular, the "Discussion" tool is aimed at using Internet-based technology to establish a two-way communication between the instructor and all the students enrolled in the course, while protecting students' privacy and limiting public access as it is the case for general WWW-based list serves or WWW pages. Additionally, the password-protected access to WebCT allows the instructor to add to his/her notes on WebCT images taken from textbooks or publications that might be protected by copyright and therefore not publishable on a public WWW page.

The "Gradebook" tool proved very useful. It was relatively easy to enter scores or grades for each assignment, and the large number of student records that we handled and the speed of the Internet connection were the only causes of delays. Both the students and I had an updated overview of their grades, something that would have been nearly impossible with simple spreadsheets and without the use of the Internet. The ability to obtain statistical information and to create histograms of the class results for individual test or assignments, or to monitor overall class progress was

Source	DF	Sum of Squares	Mean square	F value	p-value
Model	3	296.72	148.36	179.67	<0.0001
Error	431	355.89	0.82		
Corrected total	433	652.62			
Source	**DF**	**Type III SS**	**Mean square**	**F value**	**p-value**
WebCT postings made	1	6.43	6.43	7.80	0.0055
Cum_GPA	1	259.64	259.64	314.43	<0.0001
Parameter	**Estimate**	**Standard Error**	**t value**	**p-value**	
Intercept	5.49	0.15	36.65	<0.0001	
WebCT postings made	-0.06	0.02	-2.79	0.0055	
Cum_GPA	-1.015	0.057	-17.73	<0.0001	

Table 4. The effect of WebCT items posted and cumulative GPA on final grade (dependent variable) in a multiple linear regression model (434 students). Final grades were cumulated into five categories (A, B, C, D, and F).

quick and practical for me and useful for the students who wanted to compare their performance with the class average. Grade columns can be hidden or shown by choosing to publish them or not, something that allowed me to create temporary columns to track the class progress without confusing the students. At the end of the semester, I spent only a few hours adding the points, weighing the scores and finally assigning letter grades, all within WebCT.

One of the goals that I wanted to achieve by adding an Internet component with WebCT to a large class where one-on-one communication is very unpractical, if not impossible, was to promote and enhance communication with the students and amongst the students. The number of students who posted one or more "Discussion" question or item on WebCT during the semester (45%) is considerably higher than the percentage of students who would ask questions in class, which is usually not more than a handful. It is incontestable that WebCT provides a discussion forum for students who otherwise would never ask questions. It also provides the instructor with a practical means to identify concepts that are still unclear after the lecture and that need to be discussed further, or to discover what interests the students most. The majority of student postings were related to geology in general, and most often to topics discussed in class (39.6%). However, only 7% of the students made use of the extra credit opportunity given to those who posted questions that went beyond the geological concepts that we discussed in class. On the other hand, some of these questions showed extraordinary insight and inquisitive interest in the subject matter.

Throughout most of the semester the "Discussion" tool served mainly the purpose of an electronic list serve. Towards the end of the class, when the students had acquired sufficient mastery of basic geological concepts to practice and apply their critical thinking skills, I used the "Discussion" tool as a means to facilitate classroom discussion on Earth science topics relevant to society in general and to the students in particular. Since teaching in context is increasingly recognized as an essential feature of education in a complex society (Yager, 1996), I dedicated two class periods to having the students work in small groups and discuss two topics: floods and the use of dams, and global warming. The students used WebCT's "Discussion" tool to convey their group ideas and opinions and to obtain credit for it. For the flood debate, I proposed three critical thinking questions and asked the students to discuss them in small groups of 3-5 in class. Further, I encouraged them to eventually collect information outside the class to support their points of view. Each group designated a scribe who was in charge of posting on WebCT the group's ideas and to sign the posting with the group's members. The 'designated scribe' approach was used to reduce the number of postings to be graded to a manageable size and to encourage teamwork and accountability. Two hundred and fifty-four students (52.5%) participated to the flood debate in class and 59 "Discussion" postings were entered.

The setup for the global warming debate was more complex and with it I attempted to 'force' students to respond to each other's opinions and to defend points of view that might not be theirs. The students were divided into three groups depending on where they sat and were encouraged to work again in small groups. One part of the class was given the task of posting questions on global warming addressed to the two other parts of the class. One of these two groups was assigned to answer at least one of the postings made by the first group and to defend an environmentalist point of view. The last group defended a conservative point on the impact of fossil fuels on global climate and responded to one of the questions posted with data and opinions aimed to support their point of view.

Besides the benefits that students have from working in small groups (constructivist approach, e.g. Prain and Hand, 1996; Hand et al., 1999; Riggs and Kimbrough, 2002) and on discussing real issues, WebCT gave each student a means to express his or her views in spite of the large class size and the opportunity to receive credit for participating to the debate, something that would have been impossible in a traditional classroom with 250 students.
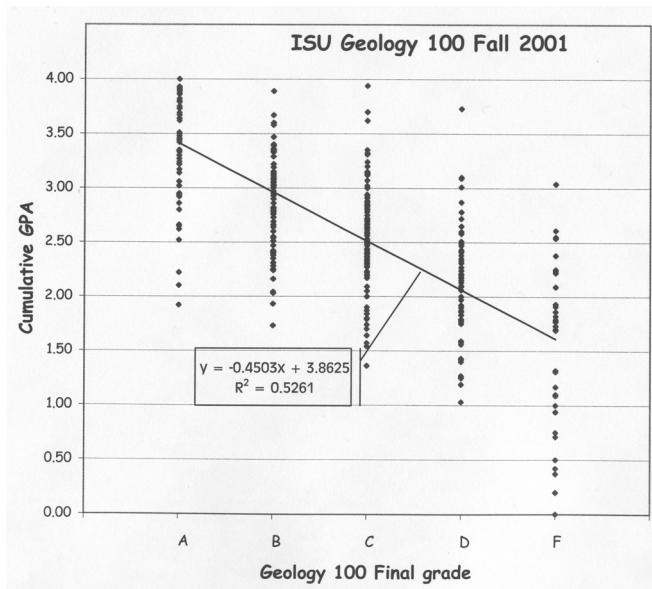
Figure 3. Cumulative GPA (Grade Point Average) of students enrolled in Geology 100 in Fall 2001 as of the end of 2001. Data on GPAs were obtained from ISU's Registrar. Three first-year students failed all classes in the fall 2001 and had a GPA of zero. The expression of the linear correlation is shown together with the correlation coefficient R^2.

The correlation between final grade and use of WebCT, and in particular of the Discussion tool, is interesting and intriguing. Although I would like to believe that using WebCT enhanced student learning, I cannot demonstrate this. To my knowledge, only one web-based writing tool, Calibrated Peer Review (Russell et al, 1998) has been shown to consistently improve student learning in various disciplines in a measurable way. It is instead likely that students who are interested in the subject matter, and who would earn good grades with or without an Internet component, are also the ones who made most use of WebCT and read and wrote most of the "Discussion postings". To test this hypothesis, I have compared the cumulative GPA of each student in the class (obtained from ISU's Registrar Office) with the final grade and the number of WebCT postings submitted in a multiple linear regression model. Since there is a very high correlation between number of WebCT logins, number of Discussion items read and items posted, I have run the correlation model using only the number of Discussion items posted as representative of WebCT use. The results (Table 4) indicate that the correlation with the cumulative GPA is significant (Figure 3), indicating that students who are generally more successful in college have also done better in my class, and have made more extensive use of WebCT.

WebCT's DISADVANTAGES

Although it proved to be a very useful tool, I did have some problems with WebCT. First, my attempt to encourage students to answer each other's questions by giving them an open forum like a bulletin board failed miserably, since only two of the topical questions posted were answered by other students and not by me. The Chat Rooms were established with the same goal in mind, but only a very small number of students made use of them and then only when they knew that the TAs or I would be available to answer questions.

Teaching several hundred students has high administrative demands related to the class, assignments, exams and logistics. By establishing a discussion forum, I had hoped to avoid having to answer to dozens of emails from students asking essentially the same question. My purpose was that posting a public answer instead of sending a private email message would have limited the number of private emails that I would receive from students. Unfortunately, most students would post a question without checking beforehand if somebody else had posted the same question and if I had answered it. This became increasingly evident as the semester progressed and annoyed other students to the point that a couple of them posted messages explaining to their peers how to use the "Discussion" forum in a more efficient way. In addition, while 376 students (78%) read at least one "Discussion" posting, many of them still preferred to email me in person. I received 513 emails during one semester and responded to 434 of them.

Most students made an effort to use good English when they wrote their questions. The knowledge that their posting was public and being read by their peers made them especially conscious of the content of their questions. In many cases, however, the spelling and grammar of the postings were sub-standard and many students used colloquial language or slang terms. The unexpected side effect of giving students the chance to communicate with each other in an open forum became evident after each exam when some students, unhappy with their scores, expressed anger at the class and me. I learned that open communication is a two-edged sword.

McKeachie (2002) points out that his success with online discussion has been variable and that he found difficult to get many students involved in it, no matter how creatively he approached the tool. Apparently what worked best in his case was to require discussion of a question each week, something that would unfortunately be quite impractical in a class of several hundred students. Calibrated Peer Review™ (Russell et al., 1998) is a fully automated system to grade written assignments, but its scope and extent goes well beyond the simple online discussion provided by WebCT and requires intensive preparation and planning.

Although the time that I spent setting up a course WWW page using WebCT was minimal, it would be misleading to say that the use of a course management software for a large introductory class would help save time. To keep up with the students' questions and to maintain the open communication environment that I had chosen to establish for my class, I spent an average of two hours each day simply answering messages. By comparison, the time I spent converting my presentations into html files and posting them on WebCT was negligible. This should be taken in consideration during the creation of the WebCT tools and the selection of tools.

CONCLUSIONS

WebCT is a very useful and easy to use class management software that allows instructors to construct and customize WWW pages for classes with a minimal time investment. WebCT allows publishing syllabus and notes, posting assignments on a calendar, and keeping track of grades. Additionally, tools are available that allow communication with individual students or in an open forum. The response of the 483 students enrolled in Geology 100 – The Earth – at Iowa State University to the use of WebCT was in general positive. Among the tools provided, both the students and I found the "Gradebook" tool particularly useful. Students also liked and used intensively the course notes and the communication tools. According to statistical data provided by WebCT on student usage and the results of an online survey, students who did well in the class made most use of WebCT and of the possibility of extensive communication with the instructor and other students. Keeping up with student questions, however, requires a considerable investment of time on the part of the instructor.

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