

ASSESSING THE RELATIVE MERITS OF COURSEWARE MANAGEMENT TOOLS USED IN ENGINEERING EDUCATION

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Abstract - Courseware management tools (CMTs) are software packages designed to facilitate developing and delivering course materials using the worldwide web (WWW). Several CMTs, possessing a broad range of capabilities, are currently available. Other tools emphasize a particular aspect of course delivery.

There are several perspectives from which a courseware management tool (CMT) may be assessed. These perspectives correspond to the individuals who are involved in delivering a course: the content expert, the web developer, the student, the teaching assistant, and the system administrator. A number of CMT feature comparisons have been conducted and are available as resources on the WWW. This evaluation was conducted in order to provide a reference for SUCCEED institutions, by which participating institutions could learn from the CMT experiences of their fellow coalition members. The overall study is undertaken with the intention of describing important CMT features and how they are used in engineering education (as opposed to general university-level courses).

Introduction

The potential benefits of instructional technology are well known and include: addressing multiple learning styles; promoting active learning; scaffolding learning; interactivity; geography-independent collaborative learning; enhancing visualization; and extending the reach of a typical course. Faculty members attempting to create materials for collections of engineering education content face several challenges. Lack of training in sound pedagogical practices, a shortage of training in the effective use of educational technology, short supply of required resources and time to produce completed and tested works, and a lack of emphasis on improved teaching in the university faculty rewards systems are the major obstacles to materials development. However, faculty realize that they must do something to provide a web presence for their courses and that they must do it without sacrificing the quality of their teaching. Thus, many faculty have turned to the use of Courseware Management Tools (CMTs) to provide the

template/infrastructure for delivering courses or course related materials over the web.

One of the first difficulties faculty must face in using CMTs is selecting the CMT that best fits their teaching/learning goals and that can be best merged into the learning environment they are creating. In many cases the goals to be accomplished by the CMT are somewhat simple e.g., a goal may be to foster students' exposure to a broad set of materials on a topic. Other goals may be more complex e.g., provide students with an experience in which they will find it necessary to have regular and meaningful collaborations in order to complete the course project. To accomplish these goals, aided by the use of technology, will likely require a faculty member to consider using one or more web tools. While addressing the question of whether or not a tool assists in driving toward a pedagogical goal, the faculty member must also determine whether a tool is appropriate for the current environment. This issue must be addressed from the standpoint of technological infrastructure and the ability to support the tool with the physical infrastructure and support personnel.

Faculty from the SUCCEED coalition have been to using CMTs for several years. Different packages were used at different schools and with varying degrees of success. All were evaluated within engineering courses and their relative strengths and weaknesses were measured against perceived needs for engineering courses. These needs are in many cases the same for courses outside of engineering.

Comparisons

For the purposes of this assessment, courseware management tools (CMTs) are defined to be software packages designed to facilitate developing and delivering course materials using the worldwide web (WWW). Several CMTs, possessing a broad range of capabilities, are currently available. Other tools emphasize a particular aspect of course delivery. For example, NetForum, developed at the University of Wisconsin specializes in providing group discussion fora. Similarly WebAssign,

which was developed at North Carolina State University (NCSU), is an automatic testing and grading facility. Alternative tools, such as WebCT (University of British Columbia), Web Course in a Box (Virginia Commonwealth University), and CourseInfo provide a comprehensive suite of tools for managing many course components including on-line testing and automatic grading, threaded discussion groups, course content delivery using web pages and streaming media, on-line grade book, student management functions, and whiteboard.

There are several perspectives from which a courseware management tool (CMT) may be assessed. These perspectives correspond to the individuals who are involved in delivering a course: the developer, the student, the teaching assistant, and the system administrator. The developer is the faculty member who creates or assembles course content. The student is, of course, the delivery target for the course content. The grader has access to some but not all of the tools and may modify a student's record of performance. The system administrator is primarily concerned with providing courseware resource requirements and CMT-related security issues.

A number of CMT feature comparisons have been conducted and are available as resources on the WWW [0-0]. This evaluation was conducted in order to provide a reference for SUCCEED institutions, by which participating institutions could learn from the CMT experiences of their fellow coalition members.

Observations

The observations summarized in Tables 1-3 represent a summary of a subset of the responses to a common evaluation instrument that was circulated to the participating institutions. The complete text of the questions used in the working form of the evaluation instrument will be reproduced in future publication. The questions reflect issues affecting course developers, students, teaching assistants, and system administrators. This paper will focus only on issues affecting faculty using the tools and on students who are taking courses presented by to the tools.

Creating and administering a course

To understand the impact that selection of a particular CMT has upon a faculty member acting as a course designer, this evaluation has included items that affect the mechanics of course creation and maintenance as well as issues of pedagogy. Table 1 describes CMT features that facilitate learning how to use a CMT, to make course content materials web-accessible, and to manage basic student information.

Documentation is a key to successful use of a CMT. Each of the CMTs provides on-line help. The WebAssign On-line

help files are supplemented with a detailed printed developer's manual. WebCT provides copious, hierarchically organized documentation that a user can print using standard browser functions. Web Course in a Box provides full Instructor and User Guides on-line in both HTML and MSWord formats. For questions that are not addressed by the on-line help, all four CMTs provide e-mail access to knowledgeable resources and Eduprise even provides telephone help. CourseInfo provides access to a reasonably rich set of documentation through local web sites.

As one might expect, documentation quality may vary with respect to the various components of a particular CMT. For example, while the wide majority of the on-line help for WebCT is both transparent and intuitive, that for the test and survey tool is complex. A significant portion of the complexity arises from the sophistication of the test and survey tool itself. The use of the test tool is further complicated by its integration with the grade book tool. The designer will find that tests and surveys can be built quickly. However, coming to an understanding of how questions, responses, and tests can be individually weighted will likely take some care and experimentation.

Each participating institution had course designers, experienced with a particular CMT technology, to serve as mentors for faculty. However, the degree to which the CMT was integrated into the institution's file systems varied widely. The tightest coupling appeared at NCSU where the NetForum and WebAssign tools are integrated into the campus information system through a locally developed tool known as WolfWare. CourseInfo was also integrated with many of the administrative systems at Virginia Tech in order to do user authentication for the password protection scheme.

For each CMT, automated tools facilitate such mundane tasks as creating accounts, uploading rolls, or setting passwords. In addition, the CMTs exploit common web browsers as the mechanism by which content is delivered. Thus, any medium, including interactive applets and streaming audio or video, supported by the browser and its "plug-ins" can be used as part of the course content.

An additional feature provided by WebCT is automatic logging of each access that a student makes to a web page. Thus, WebCT creates a record of the number of times a page is referenced as well as the pages that a particular student references. Often, page reference statistics can be used to identify trouble spots in content presentation. In addition, the reference patterns may indicate the degree to which a given student is participating in the course. This feature is an invaluable tool for faculty who are willing to review their teaching and adjust their presentations to optimize the information transfer process.

Of the five CMTs being considered, only WebCT, Web Course in a Box and CourseInfo include a whiteboard facility. The WebCT rudimentary whiteboard allows freehand drawing. In addition, it provides tools for drawing empty or filled ovals and rectangles. The whiteboard also allows typed text to be placed within the drawing area. At present, the facility does not include the capacity to share and mark a document. The Web Course in a Box and CourseInfo whiteboard includes these features and allows uploading of images and audio, has optional toolboxes to support special characters and symbols, and includes an integrated chat feature.

WebCT, Web Course in a Box, CourseInfo and Eduprise have built-in tools that enable the designer to create and modify a calendar. In WebCT, students and teaching assistants can also post items to the calendar. The WebCT calendar interface is very intuitive to use and allows students to produce hard copy of the schedule using their normal browser print function. Web Course in a box and CourseInfo also allows the designer to choose between a calendar view or schedule view (the schedule view is a date ordered listing of the items).

Course pedagogy

Whether or not a course exploits web technology, student participation in collaborative learning and student recitations are important elements of engineering course pedagogy. Table 2 describes features that the CMTs provide in support of student discussion groups and on-line recitations. NCSU uses NetForum to provide student work group collaborations and WebAssign for drill and test functions. WebCT, Web Course in a Box, CourseInfo and Eduprise include tools to provide these functions in their comprehensive suites of course management operations.

The feature sets to support group collaborations are similar for the CMTs. In each case, groups can be constructed using class rolls. A group may consist of any nonempty subset of the class. In addition, the CMTs enable group members to share correspondence whose distribution is limited to group members. The use of a web browser to provide the student interface to the course enables students at multiple institutions to participate in discussions--assuming that the student has a class account. WebCT, CourseInfo and Web Course in a Box also provide chat rooms for synchronous interactions among members of class subgroups, whole classes, and students taking multiple classes..

Table 2 also indicates that all five systems provide support for on-line quiz and drill. Under WebAssign, quizzes are constructed using an on-line question database. With WebCT and Web Course in a Box, quizzes can be written using the course designer's browser interface or they can be uploaded using appropriately delimited text files. With

Eduprise, questions are formulated by completing on-line forms.

Eduprise distinguishes between two types of assessments: tests and quizzes. Quizzes may employ only multiple choice or essay questions. Tests may in addition employ fill-in and matching questions. Neither type of assessment is timed.

WebCT and CourseInfo provide a tool that can be used to construct tests or quizzes. The questions may be multiple choice, matching, true/false, fill-in, or essay type. Except for essay questions, which must be scored manually, items are scored automatically and reported to the on-line grade book. Students may access the grade book to review their individual grades. In addition, if the WebCT course designer chooses appropriate settings, students may obtain class performance measurements including the test mean, median, maximum, and minimum scores. WebCT and CourseInfo also provide a survey tool that can be used to collect information that does not influence the content of the grade book.

Web Course in a Box provides a tool to construct practice drills and quizzes. The questions may be true false, multiple choice, short answer or essay, but only one type of question may be included on a single quiz. Except for essay questions the quizzes are scored automatically and reported in the on-line gradebook. Students may access the gradebook to review their individual scores, and the instructor may include non-WCB assignments or exams in the on-line gradebook.

WebCT, Web Course in a Box, and WebAssign allow quizzes to be timed, and both WebCT and WebAssign permit the designer to create questions with parameters that are randomly generated. All five CMTs provide mechanisms that allow the correct answers and distracters for multiple-choice questions to be presented in random order. Web Course in a Box allows the questions to be randomly selected from a larger set of questions.

Student perspective

From the student's point of view, the five CMT systems employ similar interfaces. As indicated in Table 3, the student needs to have a browser and access to the WWW. The bandwidth afforded by a 28.8Kb modem is sufficient for most CMT operations.

WebCT, Web Course in a Box, CourseInfo and Eduprise deliver course content by providing access to web pages for which html is automatically generated as a result of the course designer's work using the CMT's tools. The NetForum and WebAssign combination used at NCSU provides discussion group and quizzing infrastructure but depends upon content that is generated in html files that are created, linked, and made available by other tools. Thus, all five systems afford peer collaboration but only WebCT,

Web Course in a Box, CourseInfo and Eduprise provide tools for automatically creating and organizing content.

Conclusions

There are several concluding observations to make regarding the three approaches to course management described here. First, the approach taken by NCSU integrates a quiz tool developed in-house (WebAssign), a group collaboration tool developed at the University of Wisconsin (NetForum), and locally generated content (html) files to create a course. Consequently, this approach is less likely to be portable than the others.

WebCT, Web Course in a Box, CourseInfo and Eduprise are CMTs that integrate typically expected tools into a common environment. For these CMTs, all of the tools that are used to develop or manage a course are manipulated using a web browser. WebCT and Web Course in a Box have built-in grade books with automatic score and class statistics reporting. In addition, these three incorporate a basic whiteboard facility.

A significant difference between WebCT and Web Course in a Box, CourseInfo, and Eduprise is that the institution must provide the computer and communications infrastructure to use WebCT, or Web course in a Box whereas a remote service provider hosts Eduprise. Thus, the institution using Eduprise is not concerned with the infrastructure maintenance issues that will accrue to using other CMTs. CourseInfo can be used in either institution-supported server or externally supported server modes. However, on-campus WebCT, CourseInfo or Web Course in a Box students may see performance improvements that arise from the fact that its server is local.

For the most part all of these CMTs provide a rich set of pedagogical tools that can be used effectively in the engineering education environment. Some time savings and efficiency improvements have been noted by engineering faculty who have used these tools. However, there is still considerable room for advancing the overall learning environment and maximizing the teaching/learning improvements provided by these tools. These improvements will be brought about once faculty better understand the new teaching modes these tools provide.

References

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- <http://webct.uga.edu/hostsys/cumrec/cumrec98.html>
- <http://www.umanitoba.ca/ip/tools/courseware/>
- http://www.geocities.com/Eureka/Gold/6012/compare_web_tools.htm
- <http://www.webct.com/wichita-state-eval.html>

Table 1. Creating a Course

	NetForum & WebAssign	WebCT	Web Course in a Box	Eduprise (formerly Collegis)	CourseInfo
Getting started					
Documentation	On-line help + detailed printed manual	Good on-line help	Complete on-line manuals	Good on-line help	Manuals on-line
Sample courses	Sample questions	Yes	Yes	Yes	Yes
Local mentors	Yes	Yes	Yes	Yes	Yes
Other resources	e-mail	e-mail	e-mail, forums	Help line (24/7)	e-mail, online forum
Accounts					
Uploading rolls	Text file	Text file	Text file	Text file	Text file
Drop/add	Add yes; drop by end date change	By instructor	Add by upload, drop or add by instructor	By instructor	By instructor
"Guest" accts.	Yes, as students	Yes, as a distinct level of access	Yes, as student	Yes, as students	Yes
"Guest" access	Can be limited	Whole course	Whole course	Whole course	Whole-course
Passwords					
Creation	Automatic or by course designer	Course designer	Course designer	Automatic	Automatic
Alter/reset	Student only	Course designer	Student, designer or administrator	Course designer	Student, administrator
Access levels	Three (Instructor, student, administrator)	Five (Instructor, assistant, student, guest, administrator)	Three (Instructor, student administrator)	Three (Instructor, student, administrator)	Four (Instructor, student, developer, administrator)
Web Content					
Uploading	Designer's responsibility	Uploading tool	Uploading tool	Specify URL	Upload Tool
Media types	Any	Any	Any	Any	Any
Archive support	No	Searchable image archive	No	Vendor supplies a database	Yes
Glossary/index	No tool	Both + bookmark	No tool	Text searchable, no index	Yes
Log accesses to content pages	No tool	Yes	No	No	No
Interactive applications	User's html may link to any URL	Includes a tool to link to any URL	May link to any URL	May link to any URL	May link to any URL
Whiteboard	N/A	Yes (rudimentary)	Yes with integrated chat	No (chat includes image sharing)	Yes
Calendar					
Creation	N/A	Built-in tool	Built in tool	Built-in tool	Built-in tool
Easy to modify	N/A	Yes (built-in tool)	Yes	N/A	Somewhat
Student modifiable	N/A	Yes (for student posted items)	No	No	No

Table 2. Pedagogical issues

	NetForum WebAssign	&WebCT	Web Course in a Box	Eduprise (formerly Collegis)	CourseInfo
Discussion groups					
Directly from CMT rolls	Yes	Yes	Yes	Yes	Yes
Logging	No	Yes	Yes	Yes	Yes
Link to content	No	Yes	Yes	Yes	Yes
Limit sharing to a group	Yes	Yes	Yes	Yes	Yes
Class and proper sub-groups	Yes	Yes	Yes	Yes	Yes
Multi-institution groups	Yes	Yes	Yes	Yes	Yes
On-line recitation					
Creating quizzes	Generated using on-line database	On- or off-line	On-line forms or upload text file	Complete on-line forms	On-line forms or upload text file
File formats	N/A	Delimited text	Text	Text	Text
Question types: T/F, MC, fill-in, matching, essay	MC, fill-in, calculation	All	T/F, MC, short answer or essay	Tests -all types Quizzes- MC and essay only	T/F, MC, short answer or essay
Timed quizzes	Yes	Yes	Yes	No	No
Randomly generated questions	Yes	Yes	Yes	No	Yes
Random order of distractors	Yes	Yes	Yes	Yes	Yes
Questions linked to content	Yes	Yes	Yes	Yes	Yes
Built in grade book	Yes	Yes	Yes	No	Yes
Grade accessible to student on-line	Yes	Yes	Yes	No	Yes
Automatic grade recording	Yes	Yes (grades can also be exported)	Yes (grades can also be exported or entered manually)	No (grades must be exported)	Yes
Test or quiz statistics report	No	Score, mean, min. median, and max.	Score, mean, min and max, time to complete, also % correct for each question	Score to student; class statistics to faculty	Score, mean, min. median, and max

Table 3. Using web-delivered course content

	NetForum WebAssign	&WebCT	Web Course in a Box	Eduprise (formerly Collegis)	CourseInfo
Equipment					
Hardware/software requirements	28.8 kb modem Netscape 2.0, IE 4.0	28.8 kb modem Netscape 2.0, IE 4.0	28.8 kb modem Netscape 4.5, IE 4.0	28.8 kb modem Netscape 2.0, IE 4.0	28.8 kb modem Netscape 2.0, IE 4.0
Values added					
Peer collaboration	Yes	Yes	Yes	Yes	Yes
Organized information	N/A	Yes	Yes	Yes	Yes
Threaded discussions	Yes	Yes	Yes	Yes	Yes
Anywhere, anytime access	Yes	Yes	Yes	Yes	Yes
Review grades	Yes	Yes	Yes	Yes	Yes
Review quiz responses prior to grading	Yes	Yes	Yes	No	Yes