Evaluation of Web-based Course Management Software from Faculty and Student User-Centered Perspectives

(Phase I of the USAFA Cadet Personalized Educational Gateway Portal Project)

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Abstract:

Course management software enables faculty members to learn one software package for web-based curriculum, assessment, synchronous and asynchronous discussions, collaborative work, multimedia and interactive resource development. There are as many as 109 different course management software packages on the market and several studies have evaluated and compared various aspects of these tools. However, these studies generally focused on checklists of what these products *can do*, not what these products *need to do*, or *can do well*.

In addition, there is little data to suggest that the pages created by these software packages were easy to use by the students, or that the use of these tools by faculty increased the quality of instruction experienced by the students. Faculty and students have very different requirements for this one product, faculty need to be able to develop resources quickly and efficiently using this software, while students need to be able to find and access the course materials their instructor has assigned. Therefore, these analyses may be of limited predictive power in determining the applicability of different course management software for deployment by educational institutions.

The objective of this study was to evaluate the usability and usefulness of course management software to support traditional classroom instruction from both the faculty and student perspective. This study was done in two parts, the first part asked participants with no experience using course management software to evaluate several packages and choose the one they preferred, and the second part was a follow-up analysis after both faculty and students had used the software for an entire semester.

Faculty members and cadets found that course management software (CMS) provided a satisfactory mechanism for web-enabled curriculum delivery to supplement traditional classroom instruction at USAFA. If we had only focused on checklists of what the software products could do, then Blackboard CourseInfo and WebCT would have been considered equal, and Intralearn would have been a distant third. However, Blackboard CourseInfo received higher scores than the other products when ratings were based on user analysis of ease of use and usefulness.

Many of the features found in these products such as discussion groups, student web pages and collaborative work areas that contributed to their high number of features were not widely used, nor deemed important by both faculty and cadets. Although some faculty may use these features in the future (and subsequently cadets will use them) as they become more comfortable and familiar with the software and pedagogy, at this time a CMS with an easy to use interface that contains a grade book, automated quizzes and a place to put announcements and course documents should be preferred to one that contains many collaboration features yet also has a difficult navigational interface or hard to use development tools.

Many faculty members chose to use Blackboard CourseInfo for a follow on semester for a more in-depth analysis. Although faculty found CourseInfo served most of

their needs, many indicated that it lacked some key features necessary for deployment at USAFA, for example there was no way to divide grade books, announcements or documents into multiple sections of the same course without duplicating the entire course. Similarly, it was not possible to share calendars, quiz questions, handouts, or content among instructors teaching the same course. Therefore, this software seems best suited for providing web-enabled instructional support to a faculty member who is teaching one section of a single course, and who does not share large amounts of content with instructors teaching other sections.

As predicted, the faculty and cadets had different requirements of the CMS product for developing and accessing resources, respectively. Therefore, if only the faculty's requirements are considered, or if the product is not evaluated by all of the user groups, the probability of purchasing a sub-optimal product for a majority of the users increases. Although the requirements as stated by the faculty and cadets who had been using a CMS for an entire semester were more similar than those gathered from the naive users, often enterprise CMS purchase decisions are made prior to the purchasing of any system.

The results obtained in this part of the study will help us determine the requirements for procuring a course management software system for use here at USAFA. Giving faculty an efficient means of entering their homework assignments into a database system is the first and probably most important step to achieving the vision of an integrated portal system that includes the resources the cadets need most, access to homework and reading assignments, course materials and the ability to monitor their progress through checking their grades.

Keywords: web design usability, course management software

Section 1. Introduction

In the past few years, the World Wide Web (WWW or web) and web technologies have become accepted and valuable tools for delivering content in distance learning, as well as a means to supplement traditional classroom instruction (Brown, 2000; Halloran, 1999a; Supinski, 1999). The use of the web to support traditional classroom instruction ranges from a delivery mechanism for readings and course content to a means of expanding the curriculum outside the classroom walls, as well as a means for engaging students in interactive learning environments (Novak et al, 1999).

However, one of the drawbacks to web-enabling courses is that it may require faculty and students to acquire new technical skills, such as the ability to write HTML and other web programming language codes or proficiency with HTML editor software programs. In these cases, the technology can overshadow the teaching and learning of the course content (Poe, 2000; Taylor, 2000), and converting a course to a web-enabled platform can be very labor intensive (Campbell, 2000).

One possible way to circumvent these drawbacks is to use course management system or learning management system packages, which use templates specifically designed for web-enabled instruction. Course management systems (CMS) incorporate many different development tools into a seamless interface for web based course content. By uploading course handouts, images and files already created using other software packages such as Microsoft (MS) Word or Excel into the system, a faculty member can develop a web presence without the knowledge of HTML or other languages.

Course management software enables faculty members to learn one software package for web-based curriculum, assessment, synchronous and asynchronous discussions, collaborative work, multimedia and interactive resource development. Tracking features enable instructors to examine the use of these online resources, which can be used to make inferences about the interest and difficulty of the content as well as an individual students' level of effort. Although some faculty members may prefer to use different software for different applications, incorporating all tools into one package may decrease the need to train faculty on a variety of software products (Hazari, 2001).

Deploying a CMS at the institutional level offers students a consistent, virtual interactive environment which promotes learning and decreases the number of systems a student has to learn to accomplish routing tasks, such as finding their homework assignments or an instructor's office hours (Hazari, 2001). Another advantage is the underlying database structure of the system (e.g. Oracle, MySql, etc). A homework assignment entered by a faculty member into their course can be used to populate a student home page through a learning management portal system (Halloran, 1999b; and in prep). At the same time, it is important that the CMS does not drive the pedagogy and limit the creativity of an instructor developing sophisticated course content using a variety of different mediums.

There are as many as 109 different course management software packages on the market (Landon, 2000), and several studies have evaluated and compared various aspects of these tools (Gray, 1998; Hazari, 2001; InfoWorld, 1998; Kristapiazzi, 1998; Marshall, 1998). However, these studies generally focused on checklists of what these products *can do*, not what these products *need to do*, or *can do well*. For example, packages were evaluated by whether or not they had an asynchronous discussion feature, not whether the discussion group feature was easy to use or useful to faculty members in teaching their courses. Focusing on what a product can do is also of limited value given the rapid development and changes in product features in this market.

In addition, there is little data to suggest that the pages created by these software packages were easy to use by the students, or that the use of these tools by faculty increased the quality of instruction experienced by the students. Faculty and students have very different requirements for this one product, faculty need to be able to develop resources quickly and efficiently using this software, while students need to be able to find and access the course materials their instructor has assigned. Therefore, these analyses may be of limited predictive power in determining the applicability of different course management software for deployment by educational institutions.

1.1 Objectives of the study

The objective of this study was to evaluate the usability and usefulness of course management software to support traditional classroom education from both the faculty and student perspective. Faculty were asked to rate the different software packages not only on how easy they were to use, but how useful the features offered were to classroom instruction. Students were asked to evaluate the resulting web-enabled courses as to their ease of navigation and finding resources as well as how useful they found the different features packaged within the products. This study was done in two phases, the first phase asked participants with no experience using course management software to evaluate several packages and choose the one they preferred, and the second phase was a follow-up analysis after both faculty and students had used the software for an entire semester.

Section 2. Course Management Software Usability Tests

2.1 Background information

The United States Air Force Academy (USAFA) is a resident institution of higher education. Cadets are required to live in dormitories and attend class, and faculty members are regularly available to meet with cadets during extended office hours. There are 19 academic departments offering 31 different majors and over 500 different courses. Although USAFA does not have a distance-learning program, nor offer distance-learning courses, the instructors are encouraged to use distance learning and other information technologies to supplement the use of the traditional classroom education, when appropriate. The Academy encourages faculty to make extensive use of active-learning strategies for the classroom.

The Academy first began issuing computers to cadets in 1985, and since 1989 all cadets have had computers in their dormitory rooms. E-mail has been in place at USAFA since 1993, and instructors have been able to place class handouts on a network of shared computer drives accessible by all cadets since 1994. The Academy was linked to the internet in 1996, and many faculty now use the World Wide Web in their classrooms as a teaching tool.

With the ubiquitous computing environment here at USAFA, there is ample opportunity for faculty members to develop resources for their courses. And without coordination among departments and instructors on the development of web-enabled courses, cadets could end up having to learn as many different systems as they take courses. There is also a minimum of 24% turnover of the faculty and cadets every academic year. Any system deployed here must be intuitive in nature, and require minimum training for both sets of users, unless provisions are made to accommodate extensive training time and costs.

While it would be possible to author a custom solution CMS, the development costs of an enterprise level database driven solution are many times more than what the commercial off the shelf (COTS) products charge for license agreements over many years. In addition, many textbook publishing companies are now forming alliances with companies that produce CMS software and making these supplemental resources available to faculty and students who buy their textbooks. In order to take advantage of these services, we felt that an exploration of COTS CMS solutions was a logical first step.

Therefore, to accommodate the diversity of courses taught here at the Academy, we are interested in a system that allows for flexibility as to the type of content that can be uploaded by the faculty. However, at the same time, this system must be an easy developmental tool for the faculty, as well as provide a pedagogically sound and intuitive navigational structure for the cadets. Therefore, the objective of this portion of the study was to evaluate different commercial off the shelf CMS products to begin to understand the essential components and requirements necessary for deployment of an enterprise level course management system at USAFA.

2.2 Methods

2.2.1 Selection of software

For this study, 6 commercial software packages were scored using dichotomous (yes/no) variables as to whether they have certain features or allow for the development of key course components. Although some of the features evaluated during this process had to do with the administration of the software, I focused on those features that were user interface components. The two packages with the most features were further evaluated for usability. The faculty evaluated the product as a development tool, whereas the students evaluated the resulting courses put together by the development tool.

2.2.2 Participants

Faculty and cadet members from the United States Air Force Academy (USAFA) volunteered to participate in the study in response to an email query sent to all academic departments. Prior to beginning the study they were given a survey to assess their computer expertise including any prior experience building web pages and using the internet, both at home and as part of their course preparation. They were also asked to rate the features that were used in the dichotomous rankings of course management software as to their usefulness in teaching and learning, prior to being exposed to the course management shell software.

2.2.3 Instructor choice experiments

Instructor study participants were asked to develop a web site with a syllabus, course information, homework assignments and quizzes using two out of three CMS being evaluated. Both the software packages and the order in which they were presented to the instructors was randomized. Instructors created course content using the web authoring feature of the software package itself, and imported pre-manufactured web pages built in plain text HTML, MSFrontPage and Macromedia's Dreamweaver. They were also given MSWord documents and MSExcel spreadsheet files to upload to determine the cross compatibility of this system with other software products already in use at USAFA. The course content, handouts, syllabus, quiz questions and quiz answers were identical and supplied to the instructor. Therefore the ease or difficulty of putting together the course web site would be software dependent, not dependent on the creativity of the instructor.

After they had evaluated two CMS packages, faculty members were asked to do a side-by-side comparison of each product for 18 key components. Data collected from the instructors included time on task, ease of use, and the usefulness of the tasks using a 1-100 visual analog scale (Miller 1999). They were then asked to select one package as the best overall and to use that CMS during the Fall '00 semester.

2.2.4 Cadet choice experiments

Cadets each evaluated three courses that were built by the same person, using the same software packages evaluated by the faculty. These courses were identical with respect to course content, handouts, quiz questions and answers, assignments and other information. Each cadet evaluated two of the three courses. The courses they evaluated as well as the order in which they were presented was randomized.

Cadets were asked to navigate to specific areas within the course, take quizzes, participate in discussions, collaborate on group assignments, find their grade, and perform other tasks necessary to test the functional capability of the CMS. They were also asked to make predictions on where they would find key course documents. After they evaluated two courses, cadets were asked to complete a side-by-side comparison of the courses of each product for 12 key tasks. Data collected included time on task, ease of use and usefulness of the task using a 1-100 visual analog scale (Miller, 1999). Cadets also selected one course as their preferred course, but due to practical considerations did not use it for an entire semester.

2.2.5 Data collection and analysis

Data for both the faculty and cadets were collected by self-report on surveys and entered into a MS Excel spreadsheet. Summary statistics were calculated using MSExcel and are reported as mean $\pm$ sd unless otherwise noted. Data were imported into SPSS for further analysis. Non-parametric and parametric within subjects comparisons were performed to compare scores assigned to software packages by faculty and cadets. Unpaired t-tests were performed to examine differences between computer expertise of faculty that finished the study with faculty that did not finish the study, and for comparisons between faculty and cadets.

WebCT and Blackboard's CourseInfo were housed on a Sun Ultra Sparc 5, Intralearn software was housed on a 400 MHz NT 4.0 server with 256 MB RAM, and a 4x9 GB SCSI RAID (RAID 5) located in the Institute for Information Technology Applications laboratory in Fairchild Hall at USAFA. The web pages were accessed through the academy's intranet bypassing the proxies for efficiency and speed.

2.3 Results

2.3.1 Selection of software for further evaluation

Six software packages were dichotomously scored in May 2000 as to whether they contained key pedagogical and course management system components (Table 1). The software packages were WebCT, Blackboard CourseInfo Level 1, TopClass, Mad Duck, Intralearn, and Virtual University. Scoring was done on examination copies of the software either hosted locally or on the company's web servers. These scores were compared to other published dichotomous scorings of a similar nature (Gray, 1998; Hazarri, 1999; Kristapiazzi, 1999; Marshall, 1998; Landon, 2000) for verification. The products with the two highest scores (WebCT and CourseInfo) were chosen for further evaluations because they contained the widest variety of tools for the broadest evaluation. Intralearn was also chosen because its product uses Microsoft Office products for many of its development tools. MS Office is the standard suite of tools on the USAFA computer desktop and therefore would provide a control for familiarity.

Table 1: Dichotomous scoring of web course management software CI = CourseInfo, CT = WebCT, TC = TopClass, MD = Mad Duck, IL = Intralearn, VU = Virtual University.

	BB	CT	TC	MD	IL	VU
General Features						
Static toolbar						
Table of Contents	x	x		x	x	x
Customized "look and feel" (colors, icons, logos, etc)	x		x	x		x
Automated glossary tool		x		x	x	
Automated link to course material content	x	x	x	x	x	
Automated indexing tool	x	x				x
Search tool for course material	x	x	x		x	x
Student can make private annotations of course material	x	x	x			
Integrated Calendar tool	x	x		x		
Multi language support	x	x	x	x	x	
Instructor can define groups of students	x	x	x	x	x	
- Can assign specific material to individual or group of students	x	x	x	x		
- Collaborative work area for group	x	x			x	
- Group presentation area	x	x				
Individual presentation area/homepage	x			x		
Student file upload capability/instructor comments	x	x	x	x		x
Conforms to IMS specifications	x	x	x		x	
Conforms to W3C specifications						
Authoring features	**BB**	**CT**	**TC**	**MD**	**IL**	**VU**
Does not require knowledge of HTML	x	x	x	x	x	
Allows Java applets			x		x	
Requires plug-ins	no	no	no	no	no	no
Has drag and drop authoring features	x					
Allows Macromedia files	x	x	x	x	x	x
Allows FrontPage files	x	x			x	
Allows links to custom developed pages	x	x		x	x	x
Allows custom graphics	x			x	x	
Course Management Features	**BB**	**CT**	**TC**	**MD**	**IL**	**VU**
Class list can be entered one student at a time	x	x	x	x	x	
Class list can be uploaded as a file	x	x	x	x	x	x
Class lists can be presented, saved, and printed using Excel	x					
Online student manual	x	x	x	x	x	x
Online instructor manual	x	x	x	x		x
Course can be downloaded for safekeeping					x	
Courses can easily be moved from one server to another			x	x		
File upload capability from desktop	x	x	x	x	x	x
Student tracking features	x	x	x	x		
- can track how often student accesses pages	x	x		x		
- can track when student accesses pages	x	x		x		
- can track time spent on each page	x	x		x		

Communication Features	**BB**	**CT**	**TC**	**MD**	**IL**	**VU**
One to one course email	x	x	x	x	x	x
One to many course email	x	x	x	x	x	
Searchable asynchronous discussion	x	x			x	
Logged synchronous discussion	x	x			x	
Vitual field trips within discussion pages	x					
Shared whiteboard	x	x		x		
Adaptable for desktop videoteleconferencing		3rd				3rd
Grading Features	**BB**	**CT**	**TC**	**MD**	**IL**	**VU**
Student access to progress data available	x	x	x	x	x	x
Ability to add offline grades	x	x	x	x	x	
Grade statistics and/or histograms		x	x			
Instructor comments available with grade	x	x	x			
Scores can be emailed to instructor				x		
Scores can be stored on server	x	x		x		
Scores can be exported into Excel	x	x		x		
Quizzing features	**BB**	**CT**	**TC**	**MD**	**IL**	**VU**
Quizzes automatically graded and entered into gradebook	x	x		x	x	3rd
Allows for the following automatically graded question types:						3rd
- True -False/Multiple choice	x	x	x	x	x	3rd
- Fill in the blank	x	x		x	x	3rd
- List matching	x	x				3rd
- Essay questions	x	x				3rd
- Imagemap (click on correct part of image)						
- Short answer	x	x				
Questions can have multiple correct answers	x	x	x	x		
Can use a mixture of question types on a single quiz	x	x	x		x	
One question at-a-time testing capability			x		x	
Question file upload capability	x	x	x		x	
Customized feedback		x	x	x		
Redirect path dependent on question answers		x	x	x	x	
Timed quizzes	x	x	x	x	x	
Delivered on-line on a predetermined time and day		x				
Supports graphics files adjacent to quiz question	x	x	x			
Supports both tutorial and real exam scenarios	x	x				
Random assignment of questions to exams	x	x	x	x	x	
Allows weighting of questions so students get equal quizzes						
Has database application for quiz question bank	x	x	x			
Can be used with the following server /Operating Systems	**BB**	**CT**	**TC**	**MD**	**IL**	**VU**
Unix	x	x	x	x		x
NT	x	x	x	x	x	x
Macintosh			x	x		
Solaris	x	x	x		x	x
Linux	x	x	x			x
Other						
Total	60	59	42	43	36	17

2.3.2 Participants

Twenty-eight faculty members from the United States Air Force Academy volunteered to evaluate the course management shell software during July and August of 2000. These faculty were a representative sample of all USAFA faculty and consisted of members from all four academic divisions and staff (Table 2). There were six females and 22 males whose average age was 38.4 ± 8.9. Fifteen of these participants had Master's degrees (MA/MS/MPH) and 12 had a Ph.D or other terminal degree.

	Participants		**USAFA Faculty**	
	N	%	N	%
Male	22	78.6	429	81.0
Female	6	21.4	102	19.0
Military	17	60.7	398	75.0
Civilian	11	39.3	133	25.0
Academic Divisions:				
Humanities	6	21.4	104	19.6
Social Sciences	6	21.4	172	32.3
Basic Sciences	7	25.0	135	25.5
Engineering	6	21.4	120	22.6
Other	3	10.8		
Total	28	100.0	531	100.0

Table 2: Demographics of the faculty participants compared to the demographic makeup of all USAFA faculty.

Thirty cadets from USAFA volunteered to evaluate courses produced by the course management shell software during October 2000. These cadets were a representative sample of all cadets at USAFA with three of the four academic divisions and all class years present (Table 3). The average age of all cadets was 19.3 ± 1.2 and there were four females and 22 males in the group.

Table 3: Demographic makeup of cadet participants compared to the USAFA cadet student body. First class cadets are equivalent to seniors at civilian universities, second class to juniors, third class to sophomores and fourth class to freshmen students.

	Participants		All Cadets	
	N	%	N	%
Male	26	89.7	3557	84.7
Female	3	10.3	643	15.3
Year at the Academy				
First Class	4	13.8	874	20.8
Second Class	7	24.1	962	22.9
Third Class	10	34.5	1147	27.3
Fourth Class	9	31.0	1218	29.0
Academic Division:				
Humanities	0	0.0	239	5.7
Social Sciences	10	34.5	1189	28.3
Basic Sciences	8	27.6	521	12.4
Engineering	6	20.7	802	19.1
Undecided	6	20.7	1142	27.2
Interdisciplinary			307	7.3
Total	29	100.0	4200	100.0

2.3.3 Computer experience

Faculty participants were experienced computer users familiar with web browsing. The average participant had 12.7 $\pm$ 4.8 years experience using computers, with 5.6 $\pm$ 7.3 years experience programming computers. They averaged 5.1 $\pm$ 1.8 years of web browsing experience and routinely browse the web 5.1 $\pm$ 4.4 hours a week for both professional and personal use (Table 4).

Faculty participants were familiar with web-based curriculum materials. Seventy-eight percent of the initial participants reported having used web-based curriculum support materials at some time in the past, with 59% of the participants using web-based materials for the Fall '00 semester. Of those who used web-based materials, over half reported using resources they developed (31% of all participants). Twenty-two percent have maintained a personal web server and 30% of all participants maintain a personal website with an internet service provider outside USAFA.

Of those who have developed their own web-based content, they reported 1.5 $\pm$ 1.7 years experience developing those materials. However, the faculty had little experience using HTML authoring tools (0.6 $\pm$ 0.9 years experience) such as MS

FrontPage, Netscape Composer and Macromedia Dreamweaver[1[1]]. Faculty members reported no experience using interactive development tools such as Allaire's Cold Fusion, Microsoft Visual Studio, Macromedia Director or Macromedia Attain objects. The faculty also had no experience using any CMS products such as those being tested in this study (Table 4).

Table 4: A comparison of USAFA faculty (n = 28) and cadet (n = 30) computer experience.

Task	Faculty	Cadets	t	df	p
Years using computers	12.7	9.7	2.73	56	0.008
Years web browsing	5.1	5.5	0.89	56	0.375
Hours per week browsing the web	5.1	11.7	3.66	43.1[3]	0.001
Years developing web content	1.5	1.5	0.01	56	0.993
Years computer programming	5.6	2.0	2.50	31.5[3]	0.018
Years teaching with www-based curriculum materials[1]	5.1				
Years developing www-based curriculum materials[1]	1.8				
Number of courses using www-based curriculum materials[1]		3.0			
Maintain a personal web server at USAFA (percent)	18.0	10.0	0.86	56	0.395
Maintain a pesonal web site outside USAFA (percent)	30.0	40.0	0.81	55	0.422
Years programming HTML	0.3	0.9	1.63	36.3[3]	0.111
Years programming JAVA	0.1	0.3	1.13	31.6[3]	0.269
Years programming javascript	0.0	0.3	1.80	31.8[3]	0.081
Years using HTML development software[2]	0.4	0.5			n.s
Years using web development software[2]	0.0	0.1			n.s
Web-based Collaboration Tools[2]	0.1	0.0			n.s
Course Management Tools[2]	0.0	0.0			n.s

[1]statistical tests were not performed due to a lack of comparable question
[2]statistical tests were not performed due to inadequate sample size
[3]the degrees of freedom were adjusted for unequal variance among groups

Cadet participants were very familiar with using web-based curriculum materials. They reported that 3.0 $\pm$ 1.3 of their instructors used web-based curriculum support materials for their courses in Fall '00. Cadets have 1.5 $\pm$ 2.0 years experience developing their own web-based content. Twenty percent have at one time maintained a personal web server and 40% of all the cadets reported that they maintain a personal website with an internet service provider outside USAFA (Table 4).

Cadets had little experience using HTML authoring tools (0.3 $\pm$ 1.1 years) such as MS FrontPage, Netscape Composer and Macromedia Dreamweaver, and no experience using interactive development tools such as Allaire's Cold Fusion, Microsoft Visual Studio, Macromedia Director or Macromedia Attain objects. The cadets had no

[1[1]] Microsoft FrontPage has been included as part of the MS Office product suite available to all Faculty and Cadets since Fall 1999.

experience with web-based curriculum resources built by CMS products such as those being tested for this study.

When faculty members' computing experience was compared to cadet computing experience, faculty members had significantly more experience using and programming computers than did cadets. However, cadets spend significantly more time browsing the internet each week than do faculty. There was no significant difference between cadets and faculty in the number of years each group reported browsing the web, or developing www content.

2.3.4 Faculty who finished compared to those who did not finish the experiments.

Of the 28 faculty members who started the experiments, 15 faculty finished the experiments and 13 of the faculty did not finish the experiments. Faculty who finished the experiments did not have significantly more computer or web development experience than those faculty who did not finish the experiments for 11 different experience parameters evaluated (Table 5). Faculty who did not finish the experiments cited personal time management issues as the main reason for discontinuing the experiments.

Table 5: Comparison of computer experience for faculty who finished the evaluation of the learning management software (n=15), with faculty who did not finish (DNF) the evaluation (n=13).

Variable	Finished	DNF	t	df	p
Years using computers	12.4	13.0	0.32	26	0.750
Years web browsing	5.5	4.7	1.24	26	0.224
Years developing web content	1.4	1.5	0.15	26	0.886
Years using ftp	2.1	1.9	0.19	26	0.852
Years computer programming	5.9	5.2	0.23	26	0.823
Years developing www-based curriculum	0.9	0.7	0.68	26	0.299
Maintain a personal web server at USAFA	13.0	23.0	0.65	26	0.520
Maintain a pesonal web site outside USAFA (%)	33.0	23.0	0.58	26	0.566
Years programming HTML	0.4	0.5	0.32	26	0.755
Years programming JAVA	0.0	0.1	0.55	26	0.590
Years programming javascript	0.1	0.3	0.82	26	0.421

2.3.5 Rankings of selection criteria by faculty and cadets

When faculty and cadets were asked to rank the features used to evaluate the course management software packages (Table 1), they gave most of the features similar scores. The Grand mean rating given to all the features by faculty was 4.6 $\pm$ 0.70 and for cadets was 4.1 $\pm$ 0.82 on a 6 point scale, where 1 indicated that the feature was of very little importance, and 6 was very important or a "must have". Cadets and faculty disagreed on which features were more and less important, with the exception of one feature in each category (Table 6 and 7).

Nine features were rated 5.3 or higher and considered to be more important to faculty developing curriculum. Most of these features were course administration features or the ability to include HTML content developed independently of CMS software (Table 6). Five features received a score of 3.9 or below and were considered less important including the ability to conform to external web development specifications such as IMS, the use of discussion groups, video- teleconferencing and virtual field trips. The ability to support foreign languages and the type of operating system used to run the software received scores less than 3.2 and were designated as least important (Table 6). However, the ability to support foreign languages was rated higher by the foreign language faculty, receiving a mean rating of 5.75 on a scale of 6.

Table 6: The mean ratings of CMS features faculty (n = 29) rated significantly higher or lower than the grand mean for all features. The corresponding mean scores given by cadets (n=30) are also shown. Features that were given equivalent ratings by both groups are shown in bold. The ratings were on a 6 point scale where 1 indicated that the feature was of very little importance to web-enabled curriculum, and 6 was very important or a "must have". The grand mean score for all features was 4.6 $\pm$ 0.7 for faculty and 4.1 $\pm$ 0.82 for cadets.

Feature	Faculty	s.d.	Cadet	s.d.
more important:				
Course can be downloaded for safekeeping	5.4	0.8	4.9	1.2
Can use a mixture of question types on a single quiz	5.4	0.7	4.7	1.1
Automated link to course material	**5.3**	**0.9**	**5.2**	**1.1**
Allows links to custom developed pgs	5.3	0.7	4.6	1.5
Allows custom graphics	5.3	0.8	4.4	1.5
Class list entered one at at time or uploaded as file	5.3	1.1	4.6	1.3
Class lists can be presented, saved, printed using Excel	5.3	1.1	4.7	1.4
Quizzes automatically, graded and entered into gradebook	5.3	1	4.9	1.3
Question file upload capability	5.3	0.7	4.1	1.6
less important:				
Logged synchronous discussion	3.8	1.3	3.3	1.7
Virtual field trips within discussion pages	3.8	1.4	3.8	1.4
Adaptable for desktop videoteleconferencing	3.8	1.3	3.7	1.8
Requires plug-ins	3.5	1.7	3.4	1
Conforms to IMS specifications	**3.4**	**1.9**	**3.1**	**1.5**
least important:				
Support foreign languages	3	1.9	3	1.6
Operating System	**2.7**	**2**	**2.4**	**1.7**

Eight features were rated 5.0 or higher and considered to be more important than the others to cadets for web-enabled curriculum. The features included in this group were the ability to access grades and navigational features such as a search tool, online student manual, and static toolbar (Table 7). Six features received a score of 3.2 or below and were considered less important, including the ability to conform to external web development specifications such as IMS, the ability to support foreign languages, and the ability to track students access to the materials. The operating system used to run the

software received a score of 2.4 and was determined to be least important to the cadets (Table 7).

Table 7: The mean ratings of course management software features that cadets (n = 30) rated significantly higher or lower than the grand mean for all features. The corresponding mean scores given by faculty (n=29) are also shown. Features that were given equivalent ratings by both groups are shown in bold. The ratings were on a 6 point scale where 1 indicated that the feature was of very little importance to web-enabled curriculum, and 6 was very important or a "must have". The grand mean score for all features was 4.6 $\pm$ 0.70 for faculty and 4.1 $\pm$ 0.82 for cadets.

Feature	Cadet	s.d.	Faculty	s.d.
more important:				
Student access to progress data available	5.6	0.7	5.0	1.1
Online student manual	5.4	0.7	4.8	1.2
Search tool for course material	5.4	0.9	5.1	0.7
Table of contents	5.3	0.8	5.1	1.3
Automated link to course material content	**5.2**	**1.1**	**5.3**	**0.9**
Instructor comments with grade	5.1	1.2	5.0	1.1
Static toolbar	5.1	1.1	4.0	1.8
True-False/Multiple choice quiz questions	5.1	1.3	5.2	0.9
List matching quiz questions	5.0	1.3	5.2	0.8
less important:				
Conforms to IMS specifications	**3.1**	**1.5**	**3.4**	**1.9**
Can support foreign languages	3.0	1.6	3.0	1.9
Can track how often student accesses pages	3.0	1.5	4.7	1.2
Can track time spent on each page	3.0	1.5	4.4	1.1
Student tracking features	3.0	1.5	5.0	1.3
Can track when student accesses pages	2.9	1.4	4.6	1.1
Least immportant:				
Operating system (except for NT and linux	**2.4**	**1.7**	**2.7**	**2.0**

2.3.6 Faculty evaluation of the software for course development

Ten faculty members finished evaluations comparing CourseInfo to WebCT, and 5 faculty finished evaluations comparing CourseInfo to Intralearn. All 15 participants in both groups preferred CourseInfo over the other products evaluated, irrespective of which package they tried first. Given the unanimous choice of CourseInfo and time constraints of the faculty, we did not run a WebCT vs Intralearn comparison group and stopped recruiting more faculty members to compare CourseInfo with Intralearn once the minimum sample size of 5 individuals had been reached (Nielsen, 2000). In addition, since all faculty chose the same product, analyses to determine if preference, ease of use and time on task was dependent upon presentation order was not done.

Of the 15 faculty members who finished the experiments, three chose provide written commentary instead of completing the comparison surveys. Therefore, their data are not represented here for time on task, ease of use, or usefulness of the features evaluated. There was no significant difference between the scores given to Intralearn and

WebCT for features they shared in common, so those data have been pooled to simplify the analyses.

2.3.6a Time on task

It took faculty 1 hour and 31 minutes on average to create a web-enabled course using CourseInfo and 2 hours and 22 minutes on average to create a course identical in content using either WebCT or Intralearn (Table 8). However, this difference was not statistically significant due to inter-individual differences among participants. There was no significant difference in the amount of time it took to upload assignments, make quizzes, do simple administrative tasks or customize the look and feel of the courses between CourseInfo, WebCT and Intralearn , however it took them only one-third the time to set up a course using CourseInfo than the other products.

Table 8: The mean amount of time it took faculty at USAFA (n=12) to create a web-enabled course using one of three CMS software packages. CI = CourseInfo and Other = Intralearn and WebCT.

Task	CI	Other	t	df	p
Setup	0:18	0:55	2.20	7	0.063
Assignments	0:20	0:31	1.61	8	0.145
Quizzes	0:12	0:15	0.81	9	0.438
Administration	0:37	0:40	0.23	6	0.823
Miscellaneous	0:24	0:30	0.45	6	0.666
Customization	0:04	0:11	1.43	3	0.248
Total	1:31	2:22	1.54	9	0.158

2.3.6b Ease of Use

CourseInfo was rated significantly easier to use by faculty than the other software packages in side-by-side comparisons for 16 of the 18 tasks evaluated including creating announcements, composing quizzes, adding assignments, using collaboration features and doing administrative tasks (Table 9). All of the features were rated as *somewhat easy* to *very easy* with the exception of enrolling the cadets in class, exporting the gradebook into MS Excel, file sharing or using the group workspace, which were rated as *neutral.* The faculty scored nine features as *difficult* to *somewhat difficult* and none of the features as *somewhat easy* to *very easy* for WebCT and Intralearn (Table 9). However, faculty members did not use the online manual or ask for help significantly more often when using WebCT or Intralearn than they did when using CourseInfo (Table 10).

Table 9: Comparison of faculty (n = 12) mean ease of use scores for CourseInfo (CI) and other CMS products (WebCT and Intralearn). Anchors for this scale are 0 = very difficult, 12 = difficult, 29 = somewhat difficult, 66 = somewhat easy, 82 = easy, 100 = very easy.

Task	CI	Other	t	df	p
Course set up	86.9	28.3	8.49	11	≤ 0.001
Adding assignments	85.1	37.3	6.06	11	≤ 0.001
Uploading web pages	79.2	34.0	4.22	11	≤ 0.002
Linking other web pages	74.1	24.4	4.18	11	≤ 0.002
Composing quizzes	84.1	43.5	5.02	11	≤ 0.001
Aministrative functions overall	77.6	31.9	9.76	11	≤ 0.001
Enrolling cadets	56.1	23.7	4.96	11	≤ 0.001
Creating announcements	81.2	46.2	4.13	11	≤ 0.002
Sending email to class	83.3	28.0	7.19	11	≤ 0.001
Setting up grade book	71.5	15.4	6.67	11	≤ 0.001
Entering grades into grade book	76.1	22.9	5.34	11	0.017
Exporting gradebook into excel	62.0	18.0	3.10	11	0.011
Using discussion groups	72.1	31.4	3.20	11	≤ 0.001
File sharing	46.9	26.8	1.44	11	0.193
Group workspace	40.9	11.6	2.82	11	≤ 0.001
Calendar[1]	77.9	34.4	2.89	8	0.020
Chat rooms	71.6	31.3	4.01	11	0.003
Modifying look and feel of course[1]	68.1	45.3	3.17	8	0.110

[1]Intralean did not have this feature, so this value represents a comparison between CourseInfo and WebCT only.

Table 10: Number of times faculty (n = 12) participants accessed a manual or asked for help when using a one of three course management software products. CI = CourseInfo and Other = Intralearn and WebCT.

Type of help	CI	Other	t	df	p
Use online manual	3.2	3.4	0.17	9	0.872
Asked questions	0.2	0.7	1.25	9	0.244

The faculty also rated CourseInfo as being the most consistent with how other HTML documents were displayed when uploaded into the system. All of the packages caused one of the animated pages to have misaligned graphics, but 66% of the pages appeared the same before and after they were uploaded into CourseInfo, whereas only 50% of the pages appeared the same when uploaded into WebCT. None of the participants could find any graphics on the pages when they were uploaded into Intralearn.

2.3.6c Usefulness

The faculty rated the tasks they were asked to perform using CourseInfo significantly more useful to teaching than the tasks they were asked to complete with the other software packages in side-by-side comparisons for 17 of the 18 tasks evaluated, even though the tasks they were asked to do with each product were identical. These tasks included creating announcements, setting up the grade book, and uploading web pages created using other software products. (Table 11). All of the features were rated as *somewhat useful* to *very useful* by the faculty using CourseInfo with the exception of discussion groups, the group workspace, chat rooms and modifying the look and feel of the course, which were rated as *neutral*. The faculty scored none of the 18 tasks as *somewhat useful* to *very useful* for WebCT and Intralearn, but scored 16 of the tasks as neutral, and chat room and discussion groups *of limited use* (Table 11).

Table 11: Comparison of mean usefulness scores given by faculty (n = 12) for CourseInfo (CI) and other CMS products (WebCT and Intralearn). Anchors for this scale are 0 = not at all useful, 12 = not very useful, 29 = of limited use, 66 = somewhat useful, 82 = useful, 100 = very useful.

Task	CI	Other	t	df	p
Course set up	84.1	50.1	2.82	11	0.230
Adding assignments	87.5	44.1	3.18	11	0.015
Uploading web pages	92.1	35.7	3.48	11	0.008
Linking other web pages	74.0	36.2	2.97	11	0.018
Composing quizzes	88.1	49.0	3.05	11	0.019
Administrative functions overall	80.4	54.0	2.78	11	0.024
Enrolling cadets	76.8	43.4	2.71	11	0.027
Creating announcements	83.6	51.6	2.89	11	0.018
Sending email to class	80.1	38.4	3.32	11	0.011
Setting up grade book	79.6	44.6	2.80	11	0.021
Entering grades into grade book	78.6	51.6	2.31	11	0.046
Exporting gradebook into excel	79.5	48.3	2.37	11	0.050
Using discussion groups	53.7	26.1	2.44	11	0.040
File sharing	74.4	39.0	3.02	11	0.017
Group workspace	63.3	33.4	3.01	11	0.017
Calendar[1]	73.3	36.8	2.80	8	0.020
Chat rooms	53.8	25.0	3.01	11	0.017
Modifying look and feel of course[1]	62.8	29.9	3.17	8	0.011

[1]Intralean did not have this feature, so this value represents a comparison between CourseInfo and WebCT only.

Since the tasks they were asked to perform with each CMS package were the same, faculty should have given them the same scores, therefore it appears the scores that the faculty gave the tasks were more dependent upon the software package or whether they were easy to do, than how useful these tasks were to teaching. A regression analysis of ease of use and usefulness scores assigned for both software packages indicates that

scores that faculty assigned for usefulness were significantly dependent upon the scores faculty assigned for ease of use ($r = 0.8$, $p < 0.001$, $df = 35$).

2.3.6d Overall evaluation by faculty

CourseInfo was rated significantly higher than the other software packages for 10 statements designed to ascertain their overall experience using the software product. Faculty felt that CourseInfo had a significantly better navigational layout, was more intuitive in nature and required little training to use, as well as had pedagogically useful features. All statements as they applied to CourseInfo were rated as *moderately agree* to *decidedly agree*, except for the online user's manual and the directions given on the screen. The faculty scored seven of the 10 statements features as *moderately disagree* to *decidedly disagree* for WebCT and Intralearn including the navigational layout, the pedagogical layout, was easy to use, and needs little training to use (Table 12).

Table 12: Comparison of mean overall assessment scores by faculty (n = 12) for CourseInfo (CI) and other CMS products (WebCT and Intralearn). Anchors for this scale are 0 = decidedly disagree, 25 = moderately disagree, 50 = neutral, 75 = moderately agree, 100 = decidedly agree.

Statement	CI	Other	t	df	p
Took a reasonable amount of time	76.4	40.0	2.45	11	0.034
Had a good navigational layout	80.0	24.1	4.43	11	0.001
Had a good pedagogical layout	73.5	24.0	4.92	11	0.001
Had aesthetically pleasing screen displays	75.0	48.6	2.97	11	0.015
Was easy to use	83.6	9.6	11.20	11	0.001
Had an easy to use manual	66.0	18.5	5.16	11	0.001
Had instructive directions on the screen	67.7	23.2	5.15	11	0.001
Had pedagogically useful features	80.0	40.0	4.15	11	0.002
Was intuitive in nature	83.6	12.7	9.99	11	0.001
Needs little training to use	79.6	9.1	9.05	11	0.001

2.3.7 Evaluation of CMS courses by cadets

Twenty nine of the thirty cadets finished the evaluation of the course management software products. Of the ten cadets who evaluated courses built with CourseInfo and WebCT, seven preferred courses built with CourseInfo and only three preferred courses built with WebCT. Of the nine cadets who evaluated courses built with CourseInfo and Intralearn, all nine preferred the courses built with CourseInfo. And of the ten cadets who evaluated courses built with Intralearn and WebCT, five preferred courses built with Intralearn and five preferred courses built with WebCT.

There was no preference for software package based on the order in which the products were evaluated. Cadets chose the first package that they were presented 44.8% and the second package they were presented 55.2% of the time. Since the courses were presented to the cadets according to a randomization scheme, each course had an equal chance of being presented first or second.

To evaluate the courses, cadets located announcements and the syllabus, submitted assignments, accessed external links, used the discussion boards, took quizzes and checked their grades. Cadets were given the answers to the quizzes, and the quizzes, syllabus and supporting materials were identical for each course, however each course had a different navigational interface. The interface for CourseInfo and WebCT required the cadets to search for assignments for a particular lesson under different course headings, whereas the navigational layout for Intralearn had the daily lessons along with the assignments listed on the opening page.

2.3.7a Time on task

Cadets spent an average of 26.6 minutes evaluating each course. There was no significant difference for the overall amount of time that it took them to complete the tasks for each course (Table 13 a-c), but it took the cadets significantly less time to complete quizzes in the course built with CourseInfo than WebCT, and significantly less time to find the syllabus and supporting documents in the course built with CourseInfo than with Intralearn. Cadets spent statistically significant less time completing the evaluation on the second software package than they did the first software package (Table 14).

Table 13a: The mean amount of time in minutes it took cadets at USAFA (n=10) to navigate and access materials in web-enabled courses created with CI (CourseInfo) and WebCT.

Task	WebCT	CI	t	df	p
Locating course documents	6.5	6.5	0.00	8	1.00
Completing assignments	8.5	7.4	0.40	8	0.60
Accessing external links	1.1	0.9	1.31	8	0.22
Using communication tools	6.2	6.2	0.00	8	1.00
Taking quizzes	7.0	5.0	3.32	8	0.01
Total time	26.5	23.5	0.77	9	0.45

Table 13b: The mean amount of time in minutes it took cadets at USAFA (n=9) to navigate and access materials in web-enabled courses created with CI (CourseInfo) and Intralearn.

Task	CI	Intralearn	t	df	p
Locating course documents	4.8	7.8	3.00	8	0.01
Completing assignments	5.5	6.9	0.70	7	0.49
Accessing external links	0.9	1.8	1.45	8	0.18
Using communication tools	5.3	5.1	0.21	8	0.83
Taking quizzes	5.1	5.4	0.10	7	0.91
Total time	20.6	26.9	1.37	8	0.20

Table 13c: The mean amount of time in minutes it took cadets at USAFA (n=10) to navigate and access materials in web-enabled courses created with WebCT and Intralearn.

Task	WebCT	Intralearn	t	df	p
Locating course documents	6.5	9.2	1.71	9	0.11
Completing assignments	11.0	8.6	0.64	9	0.53
Accessing external links	1.5	2.2	1.73	9	0.11
Using communication tools	4.7	7.9	1.12	9	0.29
Taking quizzes	5.6	4.3	1.74	8	0.11
Total time	30.4	31.8	0.17	9	0.86

Table 14: The mean amount of time in minutes it took cadets at USAFA (n=29) to navigate and access materials in web-enabled courses created with CMS software by order in which the course was presented to the students.

Task	first	second	t	df	p
Locating course documents	8.0	5.9	2.74	27	0.01
Completing assignments	9.4	6.9	1.63	26	0.11
Accessing external links	1.5	1.3	0.90	27	0.37
Using communication tools	6.6	5.3	1.06	27	0.29
Taking quizzes	6.3	4.8	1.20	26	0.23
Total time	30.2	22.3	2.25	28	0.03

2.3.7b Ease of Use

There was no significant difference between courses built with Intralearn and WebCT, or between courses built with CourseInfo and WebCT for ease of use scores that cadets assigned to 12 different tasks (Tables 15a and c). Cadets rated courses built with CourseInfo significantly easier than Intralearn for 5 of the 12 tasks evaluated (Table 15b). The cadets rated most of the features as *somewhat easy* to *very easy* to use. The only features that were found *difficult* for all of the courses was using the drop box to submit assignments to the instructor. Cadets also rated using the discussion boards in the WebCT course *somewhat difficult*, as well as locating announcements, checking their grades and using the calendaring function in the Intralearn course. (note: Intralearn does not have a calendar function).

Table 15a: Comparison of cadet (n = 10) mean ease of use scores for courses built with Intralearn and WebCT. Anchors for this scale are 0 = very difficult, 12 = difficult, 29 = somewhat difficult, 66 = somewhat easy, 82 = easy, 100 = very easy.

Task	Intralearn	WebCT	t	df	p
Locating the syllabus	74.8	82.2	0.66	9	0.524
Locating the announcements	36.9	66.7	2.13	6	0.077
Locating instructor information	89.2	89.4	0.08	9	0.939
Locating the course policies	90.1	89.9	0.08	9	0.939
Locating the assignments	79.6	78.9	0.16	9	0.876
Using the drop box	26.0	37.6	0.83	6	0.437
Locating external links	68.2	89.9	1.93	9	0.086
Using the discussion boards	64.4	63.6	0.10	9	0.922
Using the calendar function	27.6	87.4	3.10	4	0.036
Taking quizzes	60.5	78.0	2.07	7	0.077
Checking your grade	53.6	73.4	1.41	7	0.201
Emailing the instructor	80.9	76.6	0.28	8	0.784

Table 15b: Comparison of cadet (n = 9) mean ease of use scores for courses built with CourseInfo (CI) and Intralearn. Anchors for this scale are 0 = very difficult, 12 = difficult, 29 = somewhat difficult, 66 = somewhat easy, 82 = easy, 100 = very easy.

Task	CI	Intralearn	t	df	p
Locating the syllabus	89.0	85.6	0.96	8	0.364
Locating the announcements	94.4	55.7	2.49	6	0.047
Locating instructor information	90.7	80.3	2.13	8	0.066
Locating the course policies	91.0	81.0	1.39	8	0.202
Locating the assignments	94.8	86.7	1.44	8	0.188
Using the drop box	69.5	32.3	2.38	7	0.049
Locating external links	95.8	70.9	2.73	8	0.026
Using the discussion boards	95.6	77.4	2.55	8	0.034
Using the calendar function	90.0	5.3	13.83	3	0.001
Taking quizzes	93.8	80.8	1.51	8	0.170
Checking your grade	82.5	55.4	1.18	7	0.277
Emailing the instructor	94.4	66.6	2.12	8	0.067

Table 15c: Comparison of cadet (n = 10) mean ease of use scores for courses built with CourseInfo (CI) and WebCT. Anchors for this scale are 0 = very difficult, 12 = difficult, 29 = somewhat difficult, 66 = somewhat easy, 82 = easy, 100 = very easy.

Task	CI	WebCT	t	df	p
Locating the syllabus	76.7	82.4	0.56	9	0.588
Locating the announcements	94.5	92.8	0.41	9	0.692
Locating instructor information	93.5	93.7	1.00	9	0.343
Locating the course policies	92.7	94.2	0.71	9	0.496
Locating the assignments	94.7	90.2	1.71	9	0.121
Using the drop box	54.2	46.9	0.52	9	0.619
Locating external links	94.5	96.0	0.60	9	0.566
Using the discussion boards	74.1	57.6	1.52	9	0.163
Using the calendar function	90.0	89.8	0.07	9	0.945
Taking quizzes	84.7	81.4	1.12	9	0.294
Checking your grade	86.3	80.2	1.19	8	0.268
Emailing the instructor	93.9	88.3	1.25	8	0.247

Cadets rated the second course they evaluated as slightly easier to use in nine of the 12 metrics examined. However, this difference was not statistically significant (Table 16).

Table 16: Comparison of cadet (n = 29) mean ease of use scores for the web-enabled courses they evaluated first and second. Anchors for this scale are 0 = very difficult, 12 = difficult, 29 = somewhat difficult, 66 = somewhat easy, 82 = easy, 100 = very easy.

Task	First	Second	t	df	p
Locating the syllabus	88.4	92.6	1.47	28	0.15
Locating the announcements	75.3	77.2	0.23	24	0.81
Locating instructor information	85.0	86.0	0.76	28	0.45
Locating the course policies	82.2	84.9	1.4	28	0.17
Locating the assignments	89.9	91.6	0.89	28	0.37
Using the drop box	49.3	60.3	1.41	28	0.16
Locating external links	87.1	83.6	0.68	28	0.5
Using the discussion boards	68.2	64.5	1.33	28	0.19
Using the calendar function	77.4	67.7	0.92	22	0.36
Taking quizzes	80.1	81.9	0.4	26	0.68
Checking your grade	69.7	78.6	0.94	27	0.35
Emailing the instructor	72.7	81.9	1.65	28	0.1

2.3.7c Usefulness:

There was no significant difference between the usefulness of the tasks cadets performed in courses built with Intralearn and WebCT for 11 of the 12 tasks, between courses built with CourseInfo and Intralearn for 9 of 12 tasks, or between courses built with CourseInfo and WebCT for 11 of 12 tasks (Tables 17a-c). As with the faculty the tasks that they were asked to evaluate were the same for each of the web-enabled courses. The cadets rated most of the features as *somewhat useful* to *very useful*. The only features

that were rated neutral were using the drop box for submitting assignments to the instructor and the discussion boards for all courses. Cadets also rated checking their grades and using the calendaring function in Intralearn as neutral.

Table 17a: Comparison of cadet (n = 10) mean usefulness scores for tasks evaluated in web-enabled courses built with Intralearn and WebCT. Anchors for this scale are 0 = not at all useful, 12 = not very useful, 29 = of limited use, 66 = somewhat useful, 82 = useful, 100 = very useful.

Task	Intralearn	WebCT	t	df	p
Locating the syllabus	92.5	95.5	0.59	9	0.572
Locating the announcements	53.0	68.0	1.25	6	0.258
Locating instructor information	78.2	79.2	1.00	9	0.343
Locating the course policies	76.8	76.8	0.00	9	0.000
Locating the assignments	88.5	91.0	1.00	9	0.343
Using the drop box	36.8	63.3	2.37	9	0.042
Locating external links	65.1	82.6	1.56	9	0.152
Using the discussion boards	49.2	52.2	0.54	9	0.604
Using the calendar function	51.3	85.5	2.28	7	0.057
Taking quizzes	78.1	85.0	1.46	7	0.188
Checking your grade	55.6	78.3	1.74	8	0.120
Emailing the instructor	77.2	67.7	0.94	9	0.370

Table 17b: Comparison of cadet (n = 9) mean usefulness scores for tasks evaluated in web-enabled courses built with CourseInfo (CI) and Intralearn. Anchors for this scale are 0 = not at all useful, 12 = not very useful, 29 = of limited use, 66 = somewhat useful, 82 = useful, 100 = very useful.

Task	CI	Intralearn	t	df	p
Locating the syllabus	95.4	89.7	1.31	8	0.227
Locating the announcements	98.6	56.3	2.57	7	0.037
Locating instructor information	93.9	85.6	1.86	8	0.100
Locating the course policies	86.1	82.3	0.59	8	0.571
Locating the assignments	85.6	89.4	0.63	8	0.546
Using the drop box	80.6	37.7	2.86	8	0.021
Locating external links	97.1	78.9	2.11	8	0.067
Using the discussion boards	86.6	84.2	0.32	8	0.760
Using the calendar function	95.0	33.4	3.22	4	0.032
Taking quizzes	95.6	90.0	1.19	8	0.269
Checking your grade	84.6	56.2	1.39	8	0.201
Emailing the instructor	95.1	72.3	1.87	8	0.098

Table 17c: Comparison of cadet (n = 10) mean usefulness scores for tasks evaluated in web-enabled courses built with CourseInfo (CI) and WebCT. Anchors for this scale are 0 = not at all useful, 12 = not very useful, 29 = of limited use, 66 = somewhat useful, 82 = useful, 100 = very useful.

Task	CI	WebCT	t	df	p
Locating the syllabus	86.1	89.9	0.59	9	0.572
Locating the announcements	87.7	87.7	0.00	9	0.000
Locating instructor information	91.1	88.9	1.49	9	0.170
Locating the course policies	88.9	85.9	1.41	9	0.193
Locating the assignments	92.4	88.7	1.14	9	0.285
Using the drop box	57.7	60.6	0.35	9	0.733
Locating external links	96.5	93.7	1.43	9	0.187
Using the discussion boards	65.7	55.8	2.93	9	0.017
Using the calendar function	74.9	86.7	1.19	9	0.267
Taking quizzes	67.8	73.7	0.55	9	0.599
Checking your grade	82.0	86.0	0.35	9	0.733
Emailing the instructor	78.7	74.7	1.00	9	0.343

2.3.7d Overall evaluation by cadets

There was no significant difference between courses built with Intralearn and WebCT for 10 statements designed to ascertain cadet's overall experience (Table 18a). Most of the statements were given a rating of *neutral.*

Table 18a: Comparison of mean overall assessment scores by cadets (n = 10) for courses built with Intralearn and WebCT. Anchors for this scale are 0 = decidedly disagree, 25 = moderately disagree, 50 = neutral, 75 = moderately agree, 100 = decidedly agree.

This software package:	Intralearn	WebCT	t	df	p
Took a reasonable amount of time	62.0	59.0	0.33	9	0.749
Had a good navigational layout	48.5	62.0	0.89	9	0.398
Had a logical layout	57.0	70.0	0.89	9	0.394
Had aesthetically pleasing screen displays	63.0	71.5	0.52	9	0.618
Was easy to use	56.0	67.5	0.91	9	0.387
Had an easy to use manual	27.5	52.5	1.67	1	0.344
Had instructive directions on the screen	47.2	47.2	0.00	9	1.000
Had useful features	69.5	79.0	1.11	9	0.297
Was intuitive in nature	52.2	72.8	1.91	8	0.093
Needs little training to use	69.0	68.0	0.09	9	0.931

The web-enabled course built with CourseInfo was rated significantly higher than the course built with Intralearn for 4 of the 10 statements used to assess the cadet's overall experience (Table 18b). Cadets rated 9 of the 10 statements as *moderately agree* to *decidedly agree* as they pertain to the CourseInfo course and only one of the statements was ranked as *moderately agree* for the Intralearn course. The other statements were rated as *neutral.*

Table 18b: Pairwise comparison of overall assessment statements by cadets (n = 9) for courses built with CourseInfo (CI) and Intralearn. Anchors for this scale are 0 = decidedly disagree, 25 = moderately disagree, 50 = neutral, 75 = moderately agree, 100 = decidedly agree.

This software package:	CI	Intralearn	t	df	p
Took a reasonable amount of time	98.1	71.5	3.58	7	0.009
Had a good navigational layout	90.6	45.6	5.50	7	0.001
Had a logical layout	92.5	55.4	4.96	7	0.002
Had aesthetically pleasing screen displays	87.5	72.5	1.98	7	0.088
Was easy to use	89.9	55.9	3.72	7	0.007
Had an easy to use manual	73.8	48.8	1.89	3	0.155
Had instructive directions on the screen	70.0	39.3	2.33	6	0.058
Had useful features	95.6	78.1	2.15	7	0.068
Was intuitive in nature	93.8	68.5	3.56	7	0.009
Needs little training to use	83.8	62.5	1.66	7	0.141

The course built with CourseInfo was rated significantly higher than the courses built with WebCT for 1 of the 10 statements used to assess the cadet's overall experience (Table 18c). However, the cadets rated 9 of the 10 statements as *moderately agree* to *decidedly agree* as they pertain to CourseInfo and only one of the statements was ranked as *moderately agree* for WebCT. The other statements were rated as *neutral*.

Table 18c: Comparison of mean overall assessment scores by cadets (n = 10) for courses built with CourseInfo (CI) and WebCT. Anchors for this scale are 0 = decidedly disagree, 25 = moderately disagree, 50 = neutral, 75 = moderately agree, 100 = decidedly agree.

This software package:	CI	WebCT	t	df	p
Took a reasonable amount of time	84.0	72.5	1.13	9	0.288
Had a good navigational layout	90.0	73.0	1.60	9	0.144
Had a logical layout	87.0	77.0	0.97	9	0.358
Had aesthetically pleasing screen displays	88.0	61.0	2.29	9	0.048
Was easy to use	86.0	69.0	1.63	9	0.136
Had an easy to use manual	91.0	62.0	1.99	4	0.118
Had instructive directions on the screen	60.0	43.1	1.86	7	0.105
Had useful features	89.8	74.0	1.57	9	0.151
Was intuitive in nature	82.5	71.5	0.91	9	0.385
Needs little training to use	81.0	68.0	1.07	9	0.311

Cadets found information where they expected to find it less that 50% of the time in any of the courses built using any of the CMS products evaluated in this series of experiments (Table 19). Cadets also reported finding course documents and other information in places where it was not located. Similarly, when faculty were asked to place documents into a course using one of these products, different faculty members put the documents in different places (Table 20).

Table 19: The locations within the course where cadets expected to find and did find the instructor's office hours and two course handouts in a web-enabled course built with one of three CMS products. The correct location of the document or information is shown in bold face font.

	Syllabus		Office location		Honors document	
BB	**exp.**	**found**	**exp.**	**found**	**exp.**	**found**
Course Information	6	13	1		7	4
Staff Information			14	19		
Course Documents	3				11	14
Other	10 (5)	6 (3)	4 (2)		2 (2)	
WebCT						
Instructor Information			11	20		
Course Documents	11	16			15	14
Other	9 (3)	5 (3)	9 (4)		5 (2)	6 (2)
Intralearn						
Syllabus	8	7	9	17	4	3
Roster			2			
Communication			1			
Other	11(3)	15 (3)	3 (3)	2 (2)	15 (6)	17(5)

Table 20: The locations where faculty placed two handouts into a course they were building using a CMS product.

	Syllabus	Honors
BB CourseInfo		
Course Information	8	4
Course Documents	6	7
Course Materials		1
Academics w/honors Clsrm pol		1
WebCT		
Course Documents		
Course Syllabus/Course Materials	6	3
File Manager	1	1
N/A	3	5
Homepage		1
Intralearn		
Syllabus		
N/A	3	2
Reference Materials		1
Uploads	1	1

2.4 Discussion

2.4.1 WWW experience by faculty and cadets

The differences between the experience of faculty and cadets in the number of years they used and developed content for the www, was not significantly different, even though faculty are more educated and have more computer experience than cadets. Both groups over-estimated the number of years they used web browsers, as many reported using these tools before they had been developed (Anderberg, 2001; Stewart, 2000). While it is possible that some participants may have used this technology in its early development and blended various aspects of the internet with the www in their answers, it is more likely this over-reporting demonstrates that the use of the www is no longer a novel concept and both groups are very comfortable using this medium.

Cadets reported using the web twice as many hours per week as faculty. While faculty reported more computer programming experience overall, cadets were just as familiar as faculty with authoring web content, and cadets were just as likely as faculty to host their own web site on a server located off the academy. However, it appears that neither group uses sophisticated development software or applications for their web sites, which is typical of most personal home pages on the www (NetKontoret, 2001).

2.4.2 Selection of CMS features by both faculty and cadets

When inexperienced participants were asked to determine what features were important and should be included in software to facilitate the development and use of web-enabled courses, both the faculty and cadets focused on their own use of the software and did not appear to consider the requirements of other user groups. Faculty did not rate features that were to be used by cadets such as finding grades or the ability to navigate the site higher than average. The faculty focused on their requirements for the tool, such as the uploading of class lists and the flexibility to add content from other resources. Both faculty and cadets rated the ability to support foreign languages as one of the least important features of these tools, yet the ability to support languages other than English would be essential for developing web-enabled curriculum for a foreign language course. The 2 foreign language instructors and the 3 cadets enrolled in foreign language courses rated this feature as a “must-have”.

Cadets also focused on their own requirements, rather than the development of the course as a whole. They rated the exam question types they favored and the ability to find materials as more important than other features. Cadets rated student tracking features, such as the ability to tell when and for how long a student accessed a page as less important than most of the other features listed, even though these resources could be used by instructors to help determine which students were at risk of not being adequately prepared for an exam or class. Since neither group seems to have considered other user’s requirements, this illustrates the need to have all user groups involved in the selection process and development of requirements for these types of tools.

Neither faculty nor cadets rated the collaboration tools, asynchronous or synchronous discussion groups, or email functions as being very important to include in

the software packages. Unlike most colleges and universities, class attendance is mandatory for all cadets at USAFA, and faculty are generally available from 7:30 to 4:30 every day outside of class time. Therefore, the ability to have online discussions, or to collaborate on projects at a distance may not be as important as it is for those using these packages for true distance learning courses, where faculty and students are separated both temporally and spatially. In addition, all faculty and cadets have institutional email accounts, and all email addresses are listed in a centralized address book. Therefore, this feature within a course management package is redundant with a system already in place and in use at USAFA.

2.4.3 Selection of preferred software package by faculty

The faculty unanimously selected Blackboard CourseInfo as the preferred CMS package of the packages they tested for developing web-enabled courses. All of the faculty surveyed indicated that they chose this package because it was the easiest to use, and most cited ease of use as the single most important factor that helped them make their decision. They indicated that the navigational interface was intuitive, it required fewer mouse-clicks, and the steps necessary to load assignments and course documents were obvious in comparison to WebCT and Intralearn.

Even though the tasks that they were asked to perform were the same, the faculty rated the course development tasks significantly more useful when using CourseInfo than with either WebCT or Intralearn. There was a strong statistical correlation between ease of use and usefulness scores for these tasks. If a task was easy to perform, the faculty tended to rate it as more useful to teaching and learning, and if the task was more difficult to perform, then the faculty rated it as less useful to teaching and learning. Therefore, even if WebCT and Intralearn had more useful tools than CourseInfo, they probably would still be rated as a less useful product overall.

One of the design features that made CourseInfo easier to use than WebCT and Intralearn was the layout of the menus that faculty encountered when using the software to build a course. The CourseInfo menu allows the user to view the different subheadings available and choose the desired function, whereas the WebCT interface only showed a few choices with each screen. In order to figure out what features might be available under a certain section, the faculty member had to click and wait for the next page to load. Intralearn also used a series of menus, however that package required the faculty member to upload all of their documents into the system first, and then go back and integrate it into the content. All of the faculty who tried to use Intralearn reported that once they uploaded a document into the system, they could not locate it.

The faculty indicated that CourseInfo did not require a lot of training, whereas WebCT and Intralearn would require a lot of training to use. However, faculty did not seek out help or use the online manuals very often when using any of the software packages. One reason may be that these courses were not going to be used outside of this evaluation process. Therefore if tasks were difficult to understand or execute, faculty could skip that section and proceed to the next set. There was no difference in computer use or programming experience between the faculty who finished the experiments and the

faculty who did not finish, which indicates that both groups had the necessary skills to finish the evaluation process. Most of the participants who did not finish, indicated that they were too busy, yet a few expressed a dislike of CMS tools overall and may have been biased because they did not like the first package that they tried. As one participant stated "the first software package was so distasteful, you could not convince me to try a second."

CourseInfo also included six out of the seven features that faculty rated as more important before they began evaluating the software packages. The only feature that was not present was the ability to upload questions as a question file, and they had not been asked to do this task as part of the evaluation process. Finding features that they had predetermined as useful may have validated their beliefs that this product was beneficial to teaching.

2.4.4 Selection of preferred software package by cadets

Cadets who compared courses prepared with CourseInfo to Intralearn, unanimously chose the course designed with CourseInfo. Although three of the cadets preferred the course designed with WebCT to the CourseInfo course, the other seven preferred the course designed with CourseInfo. Cadets were equally divided when given a choice between courses designed with WebCT and Intralearn.

Overall the cadets found all three packages easy to use, and only 34% of the cadets used the online manuals or asked for help during the process. Cadets did indicate that the second package that they tried was easier to use on average than the first package that they tried. This was probably a function of habituating to the tasks and to the worksheets, than the actual software packages. The software was assigned to the cadets in a randomized fashion so that each software package had an equal probability of being first or second. However, this was not in and of itself a deciding factor since cadets did not show a statistical bias towards choosing the second course as their overall preferred choice.

The cadets rated all of the packages with equivalent scores for the amount of training that they would require. The tasks that cadets were assigned did not take as much time as those assigned to the faculty. Instead of having to develop web-enabled courses with the software, they just had to navigate courses that were already developed. Cadets are accustomed to navigating web sites, so these tasks were probably not as novel to them as developing web-enabled courses were to the faculty. Many websites have unintuitive navigational layouts, and "hunt and click" navigation is frequently used by people who browse the web (Nielsen, 1998).

For all of the courses, the course documents were not where the cadets expected to find them, which increased the amount of time the cadets had to search to find the appropriate handout. The navigation schemes of the courses did differ with respect to layout of the assignments. Using the layouts of CourseInfo and WebCT, cadets would have to search under different headings to find all the handouts and assignments that might be due in a particular lesson. For the Intralearn course, the layout was ordered

lesson by lesson. Of the cadets that chose Intralearn over WebCT, all of them reported the navigational layout as the defining reason. This preference did not carry over into the CourseInfo tests. Even though some of the cadets preferred this navigational layout of the Intralearn course, the Intralearn course received a lower score for being intuitive than both the courses built in CourseInfo and WebCT.

Of the cadets who preferred WebCT and CourseInfo to Intralearn, they cited additional features available in both WebCT and CourseInfo, such as an integrated calendar and the ability to find their grades. Although cadets took quizzes and were asked to check their grades using all three packages, most of the cadets were unable to find their grades in the Intralearn course.

Cadets also rated the features in the courses such as asynchronous and synchronous discussion groups, integrated calendar, using external links, taking quizzes and finding their grades as useful. The only feature that cadets did not rate as useful was the drop box for submitting assignments to their instructors. Many of the cadets commented that this was redundant to submitting assignments as email attachments, which is the current system. Several cadets also commented that using a separate calendar for courses was confusing, and that they would prefer to have all of their assignments and announcements integrated into one calendaring system, which is part of the enterprise system we seek to develop and deploy at USAFA.

As with the faculty tests, features that the cadets rated as being more important than the rest were included in the courses that they favored. However, since they were not taking a real course, the grades that were posted were few and of limited importance. In addition, instructor feedback was not provided with the grades that were issued during the evaluation process. As with faculty, finding features that they had predetermined as useful may have validated their beliefs that using these products to web-enable courses was useful.

Section 3: Experienced USAFA Faculty and Cadets Rate Blackboard CourseInfo

3.1 Introduction

In section 2 of this study, both faculty and cadets evaluated CMS products using a discrete set of criteria. However, performing a task in a simulated environment is not always the same as using the tool on a daily basis. Since the faculty members and cadets are more experienced at using the tool after a semester than during the initial choice phase, they should provide finer discrimination between ease of use and the usefulness of the different features. In addition, faculty members teaching different disciplines are likely to use the tool in slightly different ways, and put documents in different areas providing variety even within a standard template. Using the tools for an entire semester can provide us data as to the frequency of use of some of the features packaged within the products, providing additional data on the importance of certain features.

Therefore, the purpose of this part of the study was to have faculty members and cadets provide final feedback on using Course Management System software and how it functioned to support the curriculum at USAFA after they had been using for the tool set for a semester. Since all of the faculty members preferred CourseInfo in the choice experiments, this was the only CMS analyzed during this phase of the study. However, the data collected on features used and the faculty's ability to use CourseInfo to web-enable curriculum at USAFA, helps to structure a list of requirements for the role of CMS software in producing an online educational environment.

3.2 Methods

3.2.1 Instructor evaluations

Thirteen Faculty members from the United States Air Force Academy (USAFA) who had been using CourseInfo to develop their online supplemental course materials for Fall '00 volunteered to answer the questionnaires in December 2000. Some of these faculty had participated in the preliminary choice experiments outlined above, but others joined the study after the completion of that phase. As with the first phase, these faculty members were asked to rate each of the features listed in Table 1 according to how important they were to producing web-enabled courses. Faculty were then asked how often they used each of the features available in CourseInfo and to rate them according to ease of use and usefulness using a 1-100 visual analog scale (Miller 1999). They were also given a series of questions designed to assess their overall satisfaction using the software.

3.2.2 Cadet evaluations

Cadets evaluated the course in which they were enrolled. They were asked to report how often they used each of the features included in Blackboard CourseInfo, and to report the ease of use and usefulness of the product on a 1-100 visual analog scale (Miller, 1999). Cadets also answered a set of questions designed to assess their overall like or dislike of Blackboard CourseInfo as a CMS, rather than their like and/or dislike of the content material of the course itself. The responses of the cadets were kept anonymous, and pooled for all courses.

3.*2.3 Data collection and analysis*

Data for both the faculty and cadets were collected by self-report on surveys and entered into a MS Excel spreadsheet. Summary statistics were calculated using MSExcel and are reported as mean $\pm$ sd unless otherwise noted. Data were imported into SPSS for further analysis. Faculty course questionnaire data was obtained from the Center for Educational Excellence. All identifiers were stripped from the data so that the identity of the individual faculty members remained anonymous.

Blackboard CourseInfo was housed on a Sun Ultra Sparc 5 server located in the Institute for Information Technology Applications laboratory in Fairchild Hall at USAFA. The web pages were accessed through the academy's intranet. Cadets and faculty were instructed to bypass the proxies for efficiency and speed.

3.3 Results

3.3.1 Faculty participants

There were 10 male and 3 female faculty members representing departments of various disciplines including Biology, Engineering Mechanics, Economics and Behavioral Sciences. Seven of the participants (54%) had created home pages for their classes in previous semesters, but for six (46%) of the participants this was their first semester creating web pages and using the web as a teaching tool. Only two (15%) of the faculty maintained additional web pages not included in the CourseInfo CMS at USAFA, and only 23% maintained a web-site with an internet service provider outside USAFA. Seven (54%) of the faculty participants chose to use Blackboard this semester because they were part of the original choice experiments (Section 2 of this report), whereas six (46%) of the faculty chose to use the software upon the recommendation of the course director overseeing the syllabus for their course.

3.3.2 Cadet participants

Fourteen male and 5 female cadets evaluated the online resources of the faculty members who were using CourseInfo during the Fall '00 semester including courses in Biology (n=10), Physics (n=3), Economics (n=2), Engineering Mechanics (n=2), and Leadership (n=1). Because the instructors using CourseInfo were teaching courses targeted to that level, the majority (15 or 79%) of the cadets who evaluated the online materials were third-class (sophomore) cadets, one first-class (senior) cadet and 2 second-class (junior) cadets. Only 8 (41.2%) of the cadets had used web-sites created by their instructors to supplement the classroom curriculum, whereas most of the cadets (n =11, 57.8%) were using this resource for the first time. None of the cadets had ever used online course materials authored using CourseInfo CMS software or other CMS packages in previous semesters.

3.3.3 Rankings of selection criteria by faculty and cadets

When experienced faculty and cadets were asked to rank features used to evaluate the course management software packages, both groups tended to give most of the features similar scores. The Grand mean rating given to the features by faculty was 4.06 $\pm$ 0.88 for faculty and 4.21 $\pm$ 0.58 for cadets on a 6 point scale where 1 indicated that the feature was of very little importance, and 6 was very important or a "must have".

Ten features were rated 5.0 or higher and considered to be more important than the others to faculty developing curriculum. Most of these features were course administration features, the ability to author content without the knowledge of HTML, grading and quizzing features (Table 21). Seven features received a score of 3.8 or below and were considered less important including the ability to support foreign languages, the use of discussion groups, video-teleconferencing, virtual field trips and the type of operating system. The ability to conform to external standardization such as IMS specifications received a rating of 2.0 and was designated as least important.

Table 21: Ratings of course management software features that faculty (n = 13) rated significantly higher or lower than the grand mean for all features. The corresponding

scores given by cadets (n=19) are also shown with features that were given equivalent ratings by both groups shown in bold. The ratings were on a 6 point scale where 1 indicated that the feature was of very little importance to web-enabled curriculum, and 6 was very important or a "must have". The grand mean score for all features was 4.06 ± 0.88 for faculty and 4.21 ± 0.58 for cadets.

Feature	Faculty	sd	Cadet	sd
more important:				
Does not require knowledge of HTML	5.5	0.1	4.9	1.2
Class lists can be presented, saved, and printed using Excel	5.5	0.7	4.1	1.5
Student access to progress data available	5.4	1.4	5.3	0.9
Class list can be uploaded as a file	5.4	0.9	4.0	1.5
Table of contents	5.1	1.0	5.0	1.1
Course can be downloaded for safekeeping	5.1	1.2	4.1	1.7
Scores can be exported into Excel	5.1	1.7	5.0	1.0
Quizzes automatically graded and entered into gradebook	5.1	1.7	5.1	1.1
Online instructor manual	5.0	1.3	4.2	1.6
Can use a mixture of question types on a single quiz	5.0	1.5	5.0	0.9
less important:				
Can Support Foreign Languages	2.9	1.8	3.7	1.8
Virtual field trips within discussion pages	2.7	1.6	3.6	1.9
Logged synchronous discussion	2.5	1.3	3.2	1.7
Shared whiteboard	2.5	1.4	3.5	1.8
Adaptable for desktop videoteleconferencing	2.4	1.5	3.8	1.8
least important				
Searchable asynchronous discussion	2.3	1.2	3.3	1.7
Operating System	2.3	5.1	3.3	1.7
Conforms to Instruction Management System specs	2.0	0.7	3.5	1.5

Twelve features were rated 4.8 or higher and considered to be more important than the others to cadets for web-enabled curriculum. The features included in this group were the ability to access grades, several quizzing features and the ability to produce web resources without knowing how to author HTML (Table 22). Thirteen features received a score of 3.6 or below and were considered least important including the ability to conform to external web development specifications such as IMS, email features, the ability to track how often and when a student accessed the online materials, asynchronous and synchronous discussion pages and the operating system used to run the software (Table 22).

Table 22: Ratings of course management software features that cadets (n=19) rated significantly higher or lower than the grand mean for all features. The corresponding scores given by faculty (n=13) are also shown with features that were given equivalent ratings by both groups shown in bold. The ratings were on a 6 point scale where 1 indicated that the feature was of very little importance to web-enabled curriculum, and 6 was very important or a "must have". The grand mean score for all features was 4.06 ± 0.88 for faculty and 4.21 ± 0.58 for cadets.

Feature	Cadet	s.d.	Faculty	s.d.
more important:				
Ability to add offline grades	5.3	0.8	4.8	1.7
Make quizzes with true-false/multiple choice questions	5.3	0.8	4.9	1.7
Student access to progress data available	5.3	0.9	5.4	1.4
One question at-a-time testing capability	5.3	2.5	4.6	1.7
Instructor comments available with grade	5.2	1.0	4.2	1.6
Quizzes automatically graded and entered into gradebook	5.1	1.1	5.1	1.7
Grade statistics and/or histograms	5.0	1.2	4.7	1.8
Scores can be exported into Excel	5.0	1.0	5.1	1.7
Table of contents	5.0	1.1	5.1	1.0
Can use a mixture of question types on a single quiz	5.0	0.9	5.0	1.5
Does not require knowledge of HTML	4.9	1.2	5.5	0.1
Fill in the blank	4.8	1.2	4.7	1.7
less important:				
Conforms to World Wide Web Consortium specs	3.6	1.5	3.3	0.9
Collaborative work area for group	3.6	1.6	3.4	1.5
One to one course email	3.6	1.6	3.7	1.7
Can track how often student accesses pages	3.6	1.5	3.9	1.0
Virtual field trips within disscussion pages	3.6	1.9	2.7	1.6
One to many course email	3.6	1.5	4.0	1.7
Shared whiteboard	3.5	1.8	2.5	1.4
Conforms to IMS specifications	3.5	1.5	2.0	0.7
Group presentation area	3.5	1.7	3.2	1.6
Individual presentation area/homepage	3.4	1.5	3.3	1.0
Searchable asynchronous discussion	3.3	1.7	2.3	1.2
Operating system	3.3	1.7	2.3	5.1
Logged synchronous discussion	3.2	1.7	2.5	1.3

3.3.4 Faculty evaluation of CourseInfo

Most of the faculty members did not use all of the features that were available in CourseInfo. The most widely used features included *adding assignments and documents*, *adding external links, creating course announcements* and the *online grade book*. Some of the faculty used the *online quizzing, student tracking, emailing* and *calendar* features, and one or none of the faculty used the *discussion boards*, *chat features* or any of the *collaborative work group* features (Table 23).

Table 23: The number of faculty that used the features and the number of times that they used each feature. N = the number of faculty that used the feature, and Mean = the number of time those faculty used the feature in a semester.

Frequency using the following features:	N	Mean	s.d.	Range
Student tracking	7	64.3	58.7	18-180
Online quizzes	8	25.9	14.8	9 - 54
Adding assignments/documents	11	23.7	10.1	9-36
Asynchronous discussions boards	1	36.0		
Chat feature	1	36.0		
Adding external links	10	22.5	12.9	9-54
Online grade book	9	70.0	82.7	18-270
Creating announcements	10	32.4	20.4	18-72
Use BB to send email to the class	5	27.0	25.5	9 - 72
File sharing	1	54.0		
Drop box	1	36.0		
Group workspace	0			
Calendar	5	25.2	9.9	18-36
Other	0			

Of the faculty who used those features, they rated *course set up, creating announcements, sending email to the class* and *grade book functions* as easy to very easy. They rated eight of the other features as somewhat easy to easy, including *adding assignments* and *uploading web pages*, *composing quizzes* and *using the calendar*. The other features were rated as neutral, or were not used by the participants (Table 24).

Table 24: Experienced faculty (n = 13) mean ease of use scores for CourseInfo (CI). Anchors for this scale are 0 = very difficult, 12 = difficult, 29 = somewhat difficult, 66 = somewhat easy, 82 = easy, 100 = very easy. N = the number of faculty that used the feature, and Mean = the average rating assigned to that feature.

Task	N	Mean	s.d.
Course set up (uploading syllabus and policies)	10	82.7	13.0
Adding assignments	8	66.3	27.4
Uploading web pages	7	74.7	12.4
Linking other web pages	8	78.9	14.0
Composing quizzes	7	75.4	19.4
Administrative functions overall	8	77.1	13.9
Enrolling cadets	8	61.4	29.4
Creating announcements	11	88.5	11.1
Sending email to class	7	95.0	6.5
Setting up grade book	8	87.4	8.4
Entering grades into grade book	10	73.8	27.8
Exporting gradebook into excell	6	84.8	9.9
Discussion groups	1	41.0	58.0
File sharing	1	32.5	46.0
Group workspace	0		
Calendar	5	77.6	22.5
Chat group	0		
Modifying look and feel of course	7	75.9	15.8

As with the original choice experiments, faculty rated those features that were easy to use as the most useful. Of the faculty who used those features, they rated six features as useful to very useful including *course set up, adding assignments, uploading web pages, and creating announcements* (Table 25). They rated five of the features as somewhat useful to useful, including *grade book functions, enrolling cadets, administrative functions* and *composing quizzes.* The other features were rated as neutral.

Table 25: Comparison of mean usefulness scores given by faculty (n = 13) for CourseInfo (CI). Anchors for this scale are 0 = not at all useful, 12 = not very useful, 29 = of limited use, 66 = somewhat useful, 82 = useful, 100 = very useful. N = the number of faculty that used the feature, and Mean is the average rating assigned to that feature.

Task	N	Mean	s.d.
Course set up (uploading syllabus and policies)	10	89.6	10.5
Adding assignments	7	91.4	18.6
Uploading web pages	7	91.4	14.6
Linking other web pages	7	88.9	14.5
Composing quizzes	8	82.5	18.0
Administrative functions overall	9	78.2	18.0
Enrolling cadets	10	77.5	19.3
Creating announcements	11	84.4	16.7
Sending email to class	8	56.0	27.2
Setting up grade book	9	71.8	28.7
Entering grades into grade book	11	70.5	27.4
Exporting gradebook into excell	7	75.1	18.4
Discussion groups	5	44.0	34.4
File sharing	5	46.4	24.7
Group workspace	5	46.4	27.7
Calendar	9	64.1	26.6
Chat group	5	46.4	27.7
Modifying look and feel of course	9	58.2	29.0

Nine of the 13 faculty indicated that it took them the same amount of time to prepare for their course using CourseInfo and only three faculty members reported that it took them more time to prepare for class using the CMS. When asked to estimate the payoff in future class preparations, four (38.5%) of the faculty indicated that it would take them less time to prepare for class in the future, now that they had some of the resources online. However, ten (61.5%) felt that it would take them the same amount of time to prepare for future classes. Nine (69.2%) of the faculty indicated they would use CourseInfo again for the spring semester, whereas 3 (30.8%) indicated that they would not be using the software product. This is in part due to the preferences of the course director.

For 10 statements designed to ascertain their overall experience using CourseInfo, faculty moderately agreed with eight out of ten of the statements. CourseInfo had a good *navigational and pedagogical layout, was easy to use, required little training to use,* as well as *had pedagogically useful features*. The faculty scored two of the 10 statements as neutral including *took a reasonable amount of time to accomplish tasks* and *had an easy to use instructor's manual* (Table 26).

Table 26: Comparison of mean overall assessment scores by faculty (n = 13) for CourseInfo. Anchors for this scale are 0 = decidedly disagree, 25 = moderately disagree, 50 = neutral, 75 = moderately agree, 100 = decidedly agree.

This software package:	N	Mean	s.d.
Took a reasonable amount of time to accomplish tasks	12	68.8	26.4
Had a good navigational layout	13	80.8	11.3
Had a good pedagogical layout	10	74.5	17.6
Had aesthetically pleasing screen displays	13	76.2	22.2
Was easy to use	13	78.1	15.9
Had an easy to use user's manual	7	65.0	21.0
Had instructive directions on the screen	12	75.0	25.2
Had pedagogically useful features	11	75.9	16.9
Was intuitive in nature	12	73.3	21.0
Needs little training to use	13	72.3	21.3

3.3.5 Cadet Evaluation of CourseInfo

Most of the cadets did not use all of the features that were available in CourseInfo. The most widely used features included *taking online quizzes*, *reading announcements* and *checking the online grade book*. Few of the cadets accessed the *online assignments* and *documents*, used the *email* function or the *online calendar* function, while two to none of the cadets used the *discussion boards, chat features* or any of the *collaborative work group features* (Table 27).

Table 27: The number of cadets that used the features and the number of times that they used each feature. N = the number of faculty that used the feature, and mean indicates the number of time those faculty used the feature in a semester.

Frequency using the following features:	N	Mean	s.d.	range
Online quizzes	15	18.0	6.1	9 - 36
Adding assignments/documents	4	27.0	9.0	18 - 36
Asynchronous discussion boards	2	22.5	6.4	18 - 27
Chat features	0			
Adding external links	2	18.0		
Online grade book	13	22.8	12.0	9 - 54
Reading announcements	13	24.2	13.4	18 - 54
Use BB to send email to your instructor	4	27.0	10.3	18 - 36
File sharing	0			
Drop box	1	36.0		
Group workspace	0			
Calendar	5	28.8	16.1	18 - 54

Of the cadets who used those features, they rated eight of the twelve features as easy to very easy to use including *locating announcements and course documents, sending email to the class* and *checking their grade*. They rated the other features as

somewhat easy to easy, including *turning in an assignment using the drop box, using the discussion boards,* and *using the calendar* (Table 28).

Table 28: Experienced cadet (n = 19) mean ease of use scores for CourseInfo (CI). Anchors for this scale are 0 = very difficult, 12 = difficult, 29 = somewhat difficult, 66 = somewhat easy, 82 = easy, 100 = very easy. N = the number of cadets who rated the feature, and Mean = the average rating assigned to that feature.

Task	N	Mean	s.d.
Locating the syllabus	16	80.9	20.7
Locating the announcements	18	86.8	19.5
Locating instructor information	18	85.4	19.2
Locating the course policies	17	83.6	19.2
Locating the assignments	19	88.9	14.8
Turning in an assignment using the drop box	8	62.4	37.9
Locating the external links	14	83.4	17.5
Using the discussion boards	7	65.6	35.7
Using the calendar function	10	69.9	35.4
Taking quizzes	16	91.1	14.8
Checking your grade	16	87.4	15.0
Emailing the instructor	8	81.3	18.4

The only CourseInfo feature that the cadets rated as useful to very useful was checking their grade (Table 29). They rated seven of the features as somewhat useful to useful including *locating the syllabus, announcements and assignments, taking quizzes and emailing the instructor.* The other features were rated as neutral.

Table 29: Comparison of mean usefulness scores given by cadets (n = 19) for CourseInfo (CI). Anchors for this scale are 0 = not at all useful, 12 = not very useful, 29 = of limited use, 66 = somewhat useful, 82 = useful, 100 = very useful. N = the number of cadets who rated the feature, and Mean is the average rating assigned to that feature.

Task	N	Mean	s.d.
Locating the syllabus	15	63.7	32.1
Location the announcements	16	70.6	28.6
Locating instructor information	16	68.9	28.1
Locating the course policies	15	58.0	34.4
Locating the assignments	17	77.8	28.1
Turning in an assignment using the drop box	9	39.1	47.4
Locating the external links	10	63.8	34.6
Using the discussion boards	9	40.2	39.9
Using the calendar function	10	56.6	41.7
Taking quizzes	15	76.7	33.8
Checking your grade	15	85.4	25.6
Emailing the instructor	9	62.9	38.7

Thirteen of the 19 cadets indicated that it took them the same amount of time to prepare for their course when the course was supplemented with materials prepared using

CourseInfo when compared to other courses taught with non-CourseInfo web sites and four cadets indicated that it took them up to four hours a week less. Only 2 cadets reported spending up to 1.5 hours more each week in class preparation. Fourteen (73.6%) of the cadets indicated they would like to use CourseInfo again during the spring semester, whereas five (26.4%) indicated that they would rather not use web sites produced by the software product.

For 10 statements designed to ascertain their overall experience using CourseInfo, cadets moderately agreed with eight out of ten of the statements. CourseInfo had a good *navigational and logical layout, was easy to use, required little training to use,* as well as *had useful features*. The cadets scored two of the 10 statements as neutral including *took a reasonable amount of time to accomplish tasks* and had an *easy to use manual* (Table 30).

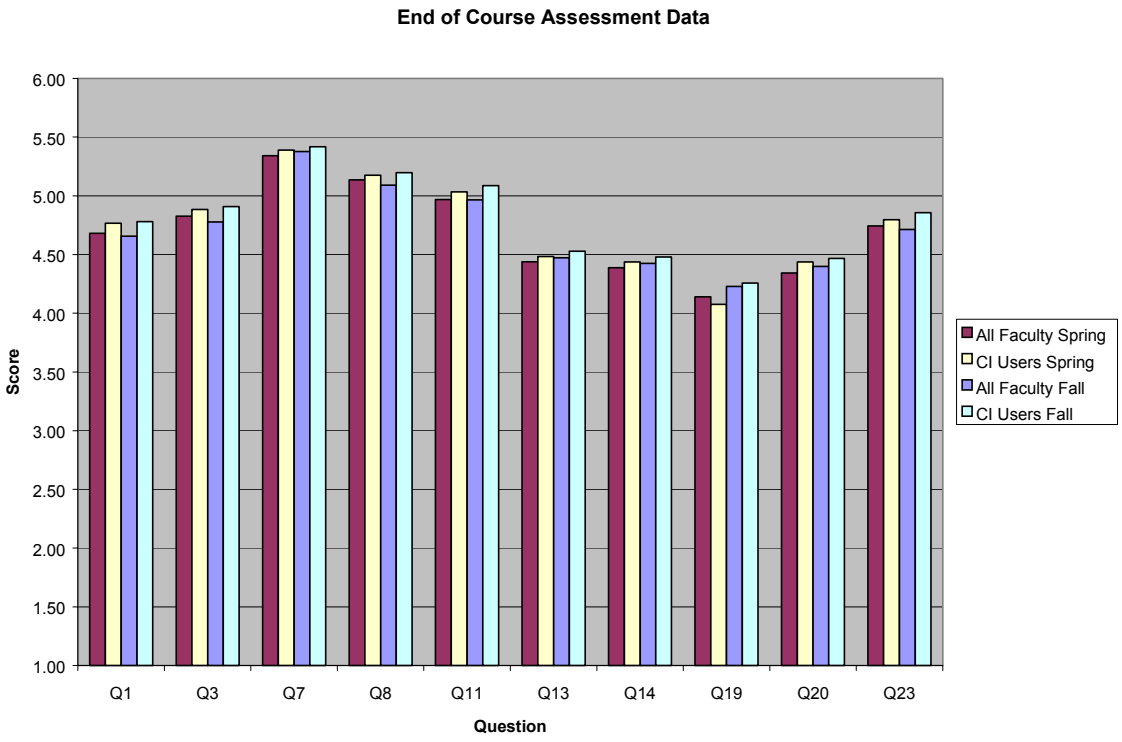
This software package:	N	Mean	s.d.
Took a reasonable amount of time to accomplish tasks	18	66.1	30.3
Had a good navigational layout	19	75.7	24.6
Had a logical layout	19	72.3	24.5
Had aesthetically pleasing screen displays	19	83.8	13.4
Was easy to use	19	80.5	23.4
Had an easy to use user's manual	16	54.6	34.7
Had instructive directions on the screen	18	73.3	25.5
Had useful features	19	73.1	24.8
Was intuitive in nature	19	72.1	26.4
Needs little training to use	19	77.3	29.0

Table 30: Comparison of mean overall assessment scores by cadets (n = 19) for CourseInfo. Anchors for this scale are 0 = decidedly disagree, 25 = moderately disagree, 50 = neutral, 75 = moderately agree, 100 = decidedly agree.

3.3.6 End of course assessment data

Faculty members who used CourseInfo received slightly higher course evaluations than other faculty members during the Fall ’00 semester (Figure 1) for ten questions chosen to assess teaching performance. However, those thirteen faculty members also received slightly higher course evaluations than the rest of the faculty in the semester before they began to use CourseInfo. In one of the core courses, half of the faculty used CourseInfo as a supplemental teaching tool and the other faculty did not use web pages to supplement their teaching. Faculty members who were using CourseInfo received higher end of course assessments than faculty who were not for that course (Figure 2).

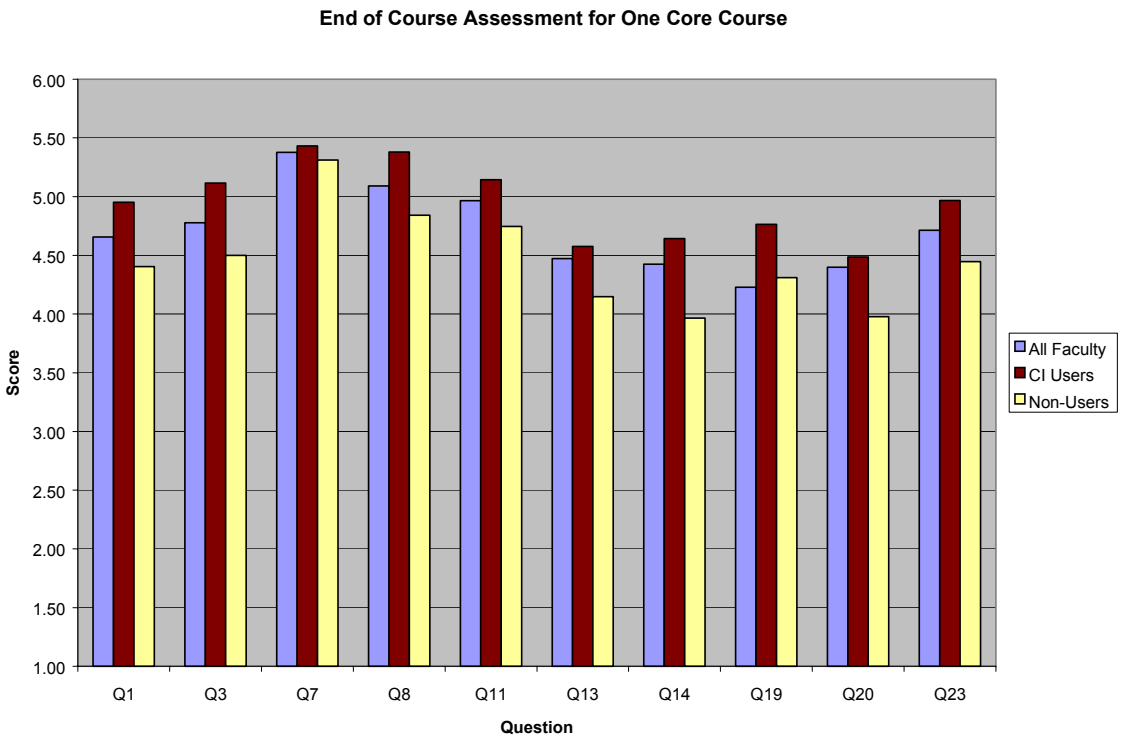
Figure 1: The end of course assessment data for the thirteen CourseInfo users during the semester they were using the product compared with all faculty during the same semester and the semester before they were using the product. The ratings were based on a 1 to 6 scale with 1 equal to very poor and 6 equal to excellent. None of the scores were statistically significant from the other scores at the 0.05 level.



Question:

1. Instructor's ability to stimulate my interest was:
3. Instructor's ability to provide clear, well-organized instruction was:
7. Instructor's knowledge of course material was:
8. As a military role model or civilian professional role model, my instructor was:
11. Availability of extra help when needed was:
13. Course organization was:
14. Clarity of course objectives and requirements was:
19. Quality and usefulness of course text(s) were:
20. The course as a whole was:
23. The instructor's effectiveness in facilitating my learning in the course was:

Figure 2: Comparison of end of course assessment data for 4 core course instructors who used Blackboard CourseInfo compared with 4 instructors teaching the same course who did not use the software or other web site supplementation. The ratings were based on a 1 to 6 scale with 1 equal to very poor and 6 equal to excellent. The differences between the scores for questions 8, 14, and 19 were statistically significant at the 0.05 level.



Question:

1. Instructor's ability to stimulate my interest was:

3. Instructor's ability to provide clear, well-organized instruction was:

7. Instructor's knowledge of course material was:

8. As a military role model or civilian professional role model, my instructor was:

11. Availability of extra help when needed was:

13. Course organization was:

14. Clarity of course objectives and requirements was:

19. Quality and usefulness of course text(s) were:

20. The course as a whole was:

23. The instructor's effectiveness in facilitating my learning in the course was:

3.4 Discussion

3.4.1 Faculty and cadet rankings of selection criteria

When participants who had been using CourseInfo for one semester were asked to determine which features were important and should be included in software to facilitate

the development and use of web-enabled courses, both faculty members and cadets followed the trend of participants from the choice experiments and focused on their own requirements. Cadets focused on the types of quiz questions that would appear on exams and the ability to check their scores online, and the faculty continued to focus on administrative procedures and quiz construction. However, there was more agreement between these two groups than from the previous experiments. Both groups felt that student access to progress data, automatically graded quizzes, using a mixture of question types on a single quiz, table of contents and the ability to create pages without the knowledge of HTML were more important than other features required of a CMS product.

The faculty members and the cadets continued to rate the discussion groups, shared whiteboards, virtual field trips and the type of operating system on which the CMS will operate as features that are not necessary, or less important than most of the other features. In addition, faculty continued to rate the support of foreign languages as less important, although there were no foreign language instructors represented in this population. The importance of a CMS to support foreign language instruction has been indicated in a separate communication as a requirement by the foreign language department.

Previously, cadets rated all student tracking features, including how often a student accesses pages, time spent on each page, and when a student accesses pages as less important than other features. However, cadets who were enrolled in courses using CourseInfo did not list these features as less important. Cadets who had not used the system prior to rating the features may have been concerned how faculty would use this information, but cadets enrolled in courses using CourseInfo did not seem to object to the way this information was used by those faculty members who chose to access student tracking features.

3.4.2. Experienced faculty ratings of Blackboard CourseInfo

Most of the faculty used CourseInfo to post documents and assignments, to send their cadets announcements, add external links, to report scores and to administer online quizzes. Of these commonly used tasks, the faculty rated most of them as somewhat easy to easy to use, as well as somewhat to very useful. When asked what they most liked about using CourseInfo, most of the faculty reported the use of automatically graded quizzes, cadet access to grade book, and a central place to post announcements and assignments. Although faculty used the online grade book, many had problems using it as designed and found it more cumbersome to enter grades into the program than into a spreadsheet such as MSExcel.

Very few of the faculty used the collaborative features of CourseInfo including the discussion boards, chat feature, file sharing, drop box or group workspace. Of those who rated those features, they were rated as neutral with respect to ease of use and usefulness. When asked what feature they would delete, ten (76.9%) indicated that they would not delete any of the components and only three (23.1%) said they would delete any of the features, naming the chat and discussion boards specifically. As stated in an

earlier section of this report, that may be influenced by our use of the product to supplement traditional classroom education, rather than to deliver distance or online courses.

Most faculty members were satisfied with the product overall and moderately agreed that it had a good pedagogical layout, pedagogically useful features, and that it did not take them more time to prepare for class than to prepare for a similar course without CourseInfo web-enabled curriculum materials. Many faculty members indicated that it lacked some key administrative features, for example there was no way to divide grade books, announcements or documents into multiple sections of the same course without duplicating the entire course. Similarly, it was not possible to share calendars, quiz questions, handouts, or content among instructors teaching the same course. Therefore, this software seems best suited for providing web-enabled instructional support to a faculty member who is teaching one section of a single course, and who does not share large amounts of content with instructors teaching other sections.

3.4.3 Experienced cadet ratings of Blackboard CourseInfo

Most of the cadets used CourseInfo to take quizzes, read announcements and access their grades. Of these commonly used tasks, cadets rated most of them as easy to very easy to use, as well as somewhat useful to useful. When asked what they liked most about using CourseInfo, most of the cadets reported the use of automatically graded quizzes with instant feedback, access to grade book, a central location for all materials and course information, and that misplaced handouts or ones not picked up in class could be printed out off the web site. One cadet also commented that using CourseInfo also wasted less paper.

Very few or none of the cadets used the interactive features of CourseInfo including the discussion boards, chat feature, file sharing, drop box or group workspace, presumably because they were not assigned by their instructor. Of those who rated those features, they rated them as somewhat easy to use and neutral with respect to usefulness. When asked what feature they would delete, only three (15.8%) indicated that they would delete anything; two of these cadets would delete the chat and discussion boards, and another cadet commented that they would delete the campus and community center pages (these sections were not part of the this test, and were therefore not populated with events).

While most cadets were satisfied with the product overall, and moderately agreed that it was easy to use, had a good logical layout, useful features, and that it did not take them more time to prepare for class than not using the web-based support materials, many cadets expressed disappointment that the faculty members were not using the software to its fullest extent. Some indicated that they would like to see more than just class notes and announcements posted. Cadets expressed interest in online quizzes and answers, and others expressed interest in the chat features. Although some of their requests may have been unrealistic ("I really don't like homework so if Blackboard could stop it, that would be nice"), this indicates that cadets are comfortable with web-enabled

curriculum support materials, and would be not be adverse to future developments in this area.

Even though CourseInfo was housed on an intranet server inside the USAFA firewall, the largest problem cited by cadets was the reliability of the connection to the web-server. Cadets reported error messages that they misinterpreted to mean the CourseInfo server was down over the duration of the entire semester. However, the server was down only one time when classes were in session during the duration of the study (April to December, 2000). Error messages were more than likely caused by other connections within USAFAnet outside the research lab housing the CourseInfo server. Cadets, like most computer users, lack the time, knowledge and adequate system information to properly troubleshoot the problem, and therefore any network problem equally impedes their ability to access the information and use the system. Before any CMS can be deployed at the enterprise level, this problem will have to be examined further and even the perception of interrupted server access must be resolved.

3.4.4 End of course critique evaluations for instructors using Blackboard CourseInfo

The faculty members who chose to participate in this study scored higher than most instructors on end of course assessments before they volunteered to use CourseInfo, as well as after they began using the product. Their scores were higher for questions that might depend on curriculum delivery method, such as those pertaining to course organization and the ability to provide clear, well-organized instruction as well as questions that should be independent of using CourseInfo, such as the ability of the instructor to be a role model and knowledge of course material. This indicates that the software was evaluated by some of the "better" teaching faculty, and that using the software did not prevent them from providing quality instruction to the cadets. In addition, most of the faculty participants had higher assessment scores after they started using CourseInfo than before, but it is unclear whether that was due to the structure provided to the course from the software product, the web-enabling of the course itself, the expertise that comes with teaching a course multiple times, the increased attention and enthusiasm paid to the course by the instructors as they tried a new teaching method, or some other variable.

A direct comparison of four instructors who used CourseInfo to provide web-enabled content to four instructors who taught sections of the same course, but did not provide any supplemental web-based materials, showed that the instructors using CourseInfo had higher end of semester course critique scores than the other group. The higher scores included clarity of course objectives and quality and usefulness of course texts. This may be due to supplementation of the course text materials with online readings and examples. These instructors also received higher ratings for being a role model, which should not be dependent on using web-enabled curriculum. It is difficult to tease apart the various factors that contribute to higher ratings, and it may be that the course critiques for these sections have nothing to do with using the technology used to enhance the courses. However, it does appear from these results that this technology does not detract from an instructor's ability to provide quality instruction.

Section 4: Overall Discussion and Conclusions

Faculty members and cadets found that course management software (CMS) provided a satisfactory mechanism for web-enabled curriculum delivery to supplement traditional classroom instruction at USAFA. Faculty were able to learn one software package for web-based curriculum, assessments, collaborative features and for communicating with their students. They did not have to learn how to use HTML, and as illustrated by the course critique assessment data, the technology did not overshadow the teaching and learning of course content.

If we had only focused on checklists of what the software products could do, then Blackboard CourseInfo and WebCT would have been considered equal, and Intralearn would have been a distant third. However, Blackboard CourseInfo received higher scores than the other products when ratings were based on user analysis of ease of use and usefulness.

Many of the features found in these products such as discussion groups, student web pages and collaborative work areas that contributed to their high number of features were not widely used, nor deemed important by both faculty and cadets. Although some faculty may eventually use these features as they become more familiar with the software and pedagogy, at this time a CMS with an easy to use interface that contains a grade book, automated quizzes and a place to put announcements and course documents should be preferred to one that contains many collaboration features, yet has a difficult navigational interface or hard to use development tools. Once the faculty has incorporated the technology into the curriculum, there is a higher probability that the cadets would then find it useful.

As predicted, the faculty and cadets had different requirements of the CMS product for developing and accessing resources, respectively. Therefore, if only the faculty's requirements are considered, or if the product is not evaluated by all of the user groups, the probability of purchasing a sub-optimal product for a majority of the users increases. Although the requirements as stated by the faculty and cadets who had been using a CMS for an entire semester were more similar than those gathered from the naive users, often enterprise CMS purchase decisions are made prior to the purchasing of any system.

To fully take advantage of the benefits of a CMS, there must be buy in from as much of the institution as possible, and course information should be integrated with other institutional databases into one system using an academic portal or other similar interface. Since one advantage of this type of software is that the students only have to learn one navigational interface and information management system, those benefits may be decreased when more than one system with different navigational and features is deployed. However, to effectively deploy only one system here at USAFA, we will need to be able to effectively share content among instructors teaching the same course, and create grade books, announcements and other materials for specific sections of multi-section courses without duplication of the entire course.

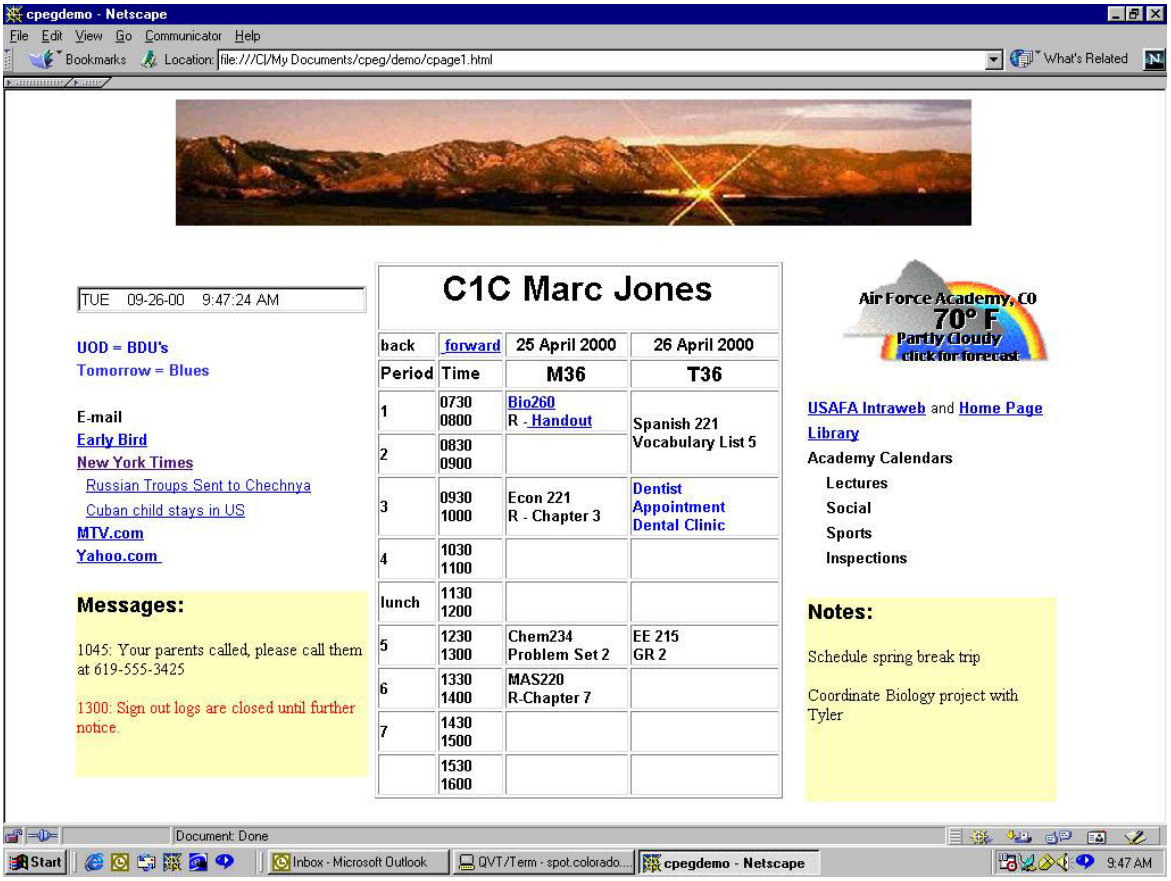
Section 5: Phase Two of the CPEG Portal Project

The results obtained in this study will help us determine the requirements for procuring course management system software for use here at USAFA. Giving faculty an efficient means of entering their homework assignments into a database system is the first and probably most important step to achieving the vision of an integrated portal system that includes the resources cadets need most; access to homework and reading assignments, course materials and the ability to monitor their own progress through checking their grades.

Following along the results of this research, the portal system that is being developed will incorporate a user-based design and analysis taking into account the needs of all users. To maximize efficiency, we will use a database model to facilitate the sharing and reusability of content. The system will be organized around a calendar that will tap into many scheduling databases currently housed independently here at USAFA as well as the course management system (Figure 3). To maximize ease of use, the system will have a single sign-on and use the inverse click rule to insure that data most important to the user will take the fewest number of mouse clicks to access.

The portal design will break up the desktop in to a series of seamless blocks or portlets. This will allow the information displayed on the desktop to be personalized to the user and optional blocks such as personal links and task lists can be customized by the user. Although this project is still under development, we anticipate a prototype to be developed during Summer 2001 and undergo usability testing during the 2001-02 academic year.

Figure 3: Prototype design for the USAFA portal or Cadet Personalized Educational Gateway system.



Section 6: Acknowledgements

I wish to thank the cadets and faculty who gave up their time to evaluate the software and to fill out numerous survey forms, especially the 13 instructors who used Blackboard CourseInfo during the fall semester and provided very thoughtful feedback at many stages during the process. I also wish to thank J. Miller for help with the experimental and survey design, D. Chuba and S. Collins for their help in data collection, entry and analysis, and D. Portillo for laboratory support. Many people provided comments on an earlier draft of this manuscript, including R. Enger and J. McCarthy. Their comments were appreciated and significantly improved the final product.

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Appendix 1: Ratings of the importance of different course management system features by faculty and cadets before and after they used Course Management Software. The ratings were on a 6 point scale where 1 indicated that the feature was of very little importance to web-enabled curriculum, and 6 was very important or a "must have".

	Before		After	
General Features	Faculty	Cadets	Faculty	Cadets
Static toolbar	4.0	5.1	4.3	4.6
Table of Contents	5.1	5.3	5.1	5.0
Customized "look and feel" (colors, icons, logos, etc)	4.4	4.2	3.7	3.8
Automated glossary tool	4.2	4.1	3.2	4.1
Automated link to course material content	5.3	5.2	4.4	4.5
Automated indexing tool	4.1	4.2	3.7	4.0
Search tool for course material	5.1	5.4	3.9	4.1
Student can make private annotations of course material	4.4	3.7	3.3	4.3
Integrated Calendar tool	4.2	3.8	3.6	4.0
Can support foreign languages	3.0	3.0	2.9	3.7
Instructor can define groups of students	4.6	3.8	4.9	3.8
- Can assign specific material to individual or group of students	4.8	4.2	3.5	4.2
- Collaborative work area for group	4.5	4.1	3.4	3.6
- Group presentation area	4.5	4.0	3.2	3.5
Individual presentation area/homepage	4.3	3.9	3.3	3.4
Student file upload capability/instructor comments	4.6	4.7	3.9	4.5
Conforms to Instructional Management System (IMS) specifications	3.4	3.1	2.0	3.5
Conforms to World Wide Web Consortium (W3C) specifications	4.1	3.7	3.3	3.6
Other:				
Authoring features				
Does not require knowledge of HTML	4.6	4.5	5.5	4.9
Allows Java applets	4.3	4.5	4.4	4.0
Requires plug-ins	3.5	3.4	4.1	4.6
Has drag and drop authoring features	5.2	4.6	4.6	4.4
Allows Macromedia files	4.3	4.1	4.2	4.1
Allows FrontPage files	4.7	4.3	4.3	4.0
Allows links to custom developed pages	5.3	4.6	4.3	4.2
Allows custom graphics	5.3	4.4	4.3	4.1
Other:				

Course Management Features				
Class list can be entered one student at a time, or uploaded as a file	5.3	4.6	4.4	4.3
Class list can be uploaded as a file	5.2	4.7	5.4	4.0
Class lists can be presented, saved, and printed using Excel	5.3	4.7	5.5	4.1
Online student manual	4.8	5.4	4.9	4.4
Online instructor manual	4.9	4.8	5.0	4.2
Course can be downloaded for safekeeping	5.4	4.9	5.1	4.1
Courses can easily be moved from one server to another	4.9	4.6	4.4	4.2
Directory upload capability from desktop	5.2	4.3	4.4	3.9
Student tracking features	5.0	3.0	4.3	4.0
- can track how often student accesses pages	4.7	3.0	3.9	3.6
- can track when student accesses pages	4.6	2.9	3.7	3.7
- can track time spent on each page	4.4	3.0	3.7	3.7
Other:				
Communication Features				
One to one course email	5.0	4.7	3.7	3.6
One to many course email	5.1	4.9	4.0	3.6
Searchable asynchronous discussion	4.1	3.5	2.3	3.3
Logged synchronous discussion	3.8	3.3	2.5	3.2
Vitual field trips within discussion pages	3.8	3.8	2.7	3.6
Shared whiteboard	4.1	4.0	2.5	3.5
Adaptable for desktop videoteleconferencing	3.8	3.7	2.4	3.8
Other:				
Grading Features				
Student access to progress data available	5.0	5.6	4.4	5.3
Ability to add offline grades	5.0	5.0	4.8	5.3
Grade statistics and/or histograms	4.9	4.7	4.7	5.0
Instructor comments available with grade	5.0	5.1	4.2	5.2
Scores can be emailed to instructor	5.0	4.6	4.6	4.7
Scores can be stored on server	4.8	4.8	4.6	4.8
Scores can be exported into Excel	5.2	4.7	5.1	5.0
Other:				

Quizzing features				
Quizzes automatically graded and entered into gradebook	5.3	4.9	5.1	5.1
Allows for the following automatically graded question types:				
- True -False/Multiple choice	5.2	5.1	4.9	5.3
- Fill in the blank	5.1	4.0	4.7	4.8
- List matching	5.2	5.0	4.7	5.1
- Essay questions	4.8	3.3	4.2	4.2
- Imagemap (click on correct part of image)	4.9	4.5	4.0	4.8
- Short answer	5.0	3.5	4.4	4.5
Questions can have multiple correct answers	4.7	3.6	4.4	4.3
Can use a mixture of question types on a single quiz	5.4	4.7	5.0	5.0
One question at-a-time testing capability	5.1	4.5	4.6	5.3
Question file upload capability	5.3	4.1	4.8	4.5
Customized feedback	5.2	4.6	4.7	4.8
Redirect path dependent on question answers	4.5	3.7	4.2	4.5
Timed quizzes	4.6	3.4	3.8	3.7
Delivered on-line on a predetermined time and day	4.7	3.9	4.5	4.4
Supports graphics files adjacent to quiz question	4.9	4.5	4.9	4.2
Supports both tutorial and real exam scenarios	5.0	4.7	4.3	4.5
Random assignment of questions to exams	4.7	4.3	3.9	4.6
Allows weighting of questions so students get equal quizzes	5.0	4.7	3.8	4.6
Other:				
Can be used with the following server /Operating Systems				
Unix	3.5	2.6	2.8	3.2
NT	5.1	3.8	4.5	3.7
Macintosh	2.6	2.8	2.0	3.3
Solaris	2.6	2.2	2.0	3.3
Linux	2.7	3.0	2.5	3.3
Other:				