

## Developing an Evaluation Framework for a Custom-designed Course Management System

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### *Abstract*

*This study evaluated a custom-designed course management system in use at a mid-sized public institution in the Pacific Northwest region of the United States. While focusing primarily on gathering information relevant to the continued development of the course management system, this study sought to identify the relationship among user characteristics, usability factors, and acceptance of the course management system. Additionally, this study sought to identify common usability problems with specific course features encountered by the users. Participants in this study were 308 undergraduate and graduate students who were currently using the online course management system to take an Internet-enhanced or fully Internet-delivered course. The data collected via an online survey instrument indicated that three usability factors, ease of navigation, ease of learning, and visual perception were significant predictors of acceptance of the course management system. The usability of specific course management system features was examined using both Likert-scale items and content analysis of open-ended survey questions. The content analysis of the open-ended items revealed several specific problems that were commonly encountered while using specific course features. Based on these findings, several recommendations are made toward the improvement of the custom-designed course management system and also toward the improvement of the survey instrument for future use.*

### **Introduction**

The rapid expansion in efforts to deliver Internet-based courses at universities, colleges, and corporations around the world has resulted in the development of numerous and varied forms of software designed to develop and deliver such courses. In an effort to increase the efficiency, effectiveness, and reusability of online courses, many institutions have either adopted a commercial course management system or developed a custom-built Internet-based application as a medium for developing and delivering course content and interactive learning resources. While all of these solutions have their advantages and disadvantages (Ingraham, 2002), the impact that course management systems have on the success or failure of web-based courses can be significant.

Many factors have been identified that contribute to the success of online courses such as availability and reliability of technology, standards for course design, instructor training, etc. (Institute for Higher Education Policy, 2000). Central to these and other necessary conditions for a successful online course is the importance of the technology medium through which teaching and learning is facilitated. Usability, broadly defined as the degree to which a user is able to effectively and efficiently make use of a software product for its intended purpose (Blandin, 2003; Koohang, 2004; Koohang & du Plessis, 2004; Mehlenbacher, 2002; Reeves et al., 2002; Sims, 2001), is a combination of several factors that are essential to the success and acceptances

of a software medium for teaching and learning online. Studies have shown that factors of usability are predictors of engagement in online courses (Miller, Rainer, and Corley, 2003), as well as influencing students overall comfort and attitude toward online and computer mediated instruction (Koohang, 2004; Squires & Preece, 1996). For these reasons, a usability evaluation of online learning and course management systems provides an indication of the degree to which several essential conditions for successful online teaching and learning are met.

While usability of a course management system is only one of the factors that influences the success of online courses, it is one of the few factors that can be improved by modifying the web-based application. Other factors that influence the success of online courses and programs, such as institutional support, faculty compensation for online teaching, or maintaining student interaction are more difficult to manipulate in order to improve online teaching and learning. The usability of the software medium through which the courses are delivered, however, can be improved by making revisions to the software based on information gained from a focused usability evaluation. As more institutions and educational organizations continue to develop custom-designed course management systems, it becomes increasingly important for such efforts to have the ability to evaluate these efforts and to modify the software in order more efficiently identify and solve usability problems that adversely influence teaching and learning in an online environment.

### ***Overview of the course management system***

The course management system (CMS) examined in this study was developed in order to provide the software framework through which online courses could be offered as part an Internet-based Master of Education degree program. The Interactive Virtual Courseware management system (IVCMS) was designed by in-house developers who had previously worked with faculty to design online courses and was intended to address the needs of delivering both Internet-based and Internet-enhanced courses for graduate students. With regards to the technical aspects, the IVCMS used Active Server Pages (ASP) technology for all interactive portions of the system in conjunction with a Structured Query Language (SQL) database system for all data storage.

The IVCMS offers features to provide an online syllabus, dynamic course outline, threaded discussion boards, journals, grade book, course roster, and assignment drop-box as well as course communication features such as announcements and class emailing capabilities. To date, the IVCMS has been used by over 5000 students, faculty and instructors at three institutions of higher education. Approximately 70 courses are offered via the course management system each semester.

### ***Rationale for the Study***

In general terms, the goal for both commercial and custom-built course management systems is the same; to provide a medium by which course materials can be delivered and accessed in a web-based platform as well as provide the technology medium for interaction among a learning community. To better serve this purpose, course management systems are continually undergoing further development to increase the effectiveness of the system in meeting the needs of institutions at which these application are in use. However, the methods most commonly used to evaluate other types of software systems are often too narrow in scope to

provide information that is directly applicable to a course management system. Also, many types of evaluation that do focus on software used for educational purposes tend to focus on factors not directly related to the course management system such as course content. While these methods are useful in many contexts, a modification of these methods is necessary in order to specifically examine the course management system and its relationship to the overall system of web-based education. Tselios, Avourise, Dimitracopoulou, and Daskalaki (2001), in reference to Hienes (2000), describes this lack of standard evaluation techniques by saying that there are “no established techniques relating to distance-learning environments usability evaluation” (p. 357).

Prior to this study, the evaluation of the IVCMS has recently been done less formally with input both from faculty who have used the software to teach courses and students who are enrolled in web-based courses delivered using the system. At the current stage of development, however, it has become necessary to conduct a more comprehensive evaluation of how well the web-based course management system is meeting the needs of the users in order to guide the future development of the software. An ongoing and cyclical process of research and development will yield information that can be used to improve the overall effectiveness of an online learning and course management system. It is necessary to not only conduct an evaluation of the course management system in its current state, but also to develop the framework by which the software can continue to be evaluated as it is further developed and redesigned. Because of budget and personnel constraints, it is also vital to focus the evaluation framework on methods that can be employed that are resource efficient.

### *Significance of the Study*

While there is currently an ongoing effort to make use of the Internet for teaching and learning, according to the Web-Based Education Commission there is a need for purposeful research that “leads to enhanced learning performance” (2000). Studies that examine the relationship between usability of web-based systems and learning suggest that improving the usability of the course management system software can reduce or eliminate some of the barriers to success of online courses and the teaching and learning process (Halloran, 2001; Koohang, 2004; Liaw, 2002; Psaromiligkos & Retalis, 2003; Retalis & Psaromiligkos; Retalis et al., 1998; Squires & Preece, 1996, 1999; Tselios et al., 2001).

Determining the influence of computer literacy and experience with Internet-based courses on both usability and acceptance will provide both a better understanding of the characteristics of the users of the system, and also provide a foundation on which additional support systems can be designed. Stoel & Lee (2003) suggest that as experience with Web-based courseware increases, measures of acceptance will also increase. Morss (1999) examined the differences in experience with computers as a possible influence on users’ perceptions of the WebCT course management system and determined that the majority of the students (83.3% overall) believed their computer skills to be adequate for taking a course in WebCT. The results of this study will indicate the level of computer skills perceived by the users of the system and the relationship between this perception and usability and acceptance ratings.

While information regarding user characteristics will provide insight into the nature of the users of the course management system, there is also a need to identify specific features of the system which are in need of improvement. To this end, examining user ratings of the ease of use for each course feature as well as examining specific problems identified by users will allow for any specific problems to be identified and solutions to be developed. A more thorough examination of the course features and possible problems with these features will provide a

better understanding of common problems encountered by the students and the background necessary to develop a solution to these problems.

Overall, the results of this study will inform the software designers further developing the IVCMS or similar products, those involved in providing professional development for faculty and instructors who are teaching Internet-based courses, and the decision-makers who wish to focus on improving quality, effectiveness, and efficiency of online courses and programs. This study will not only provide information focused on improving the course management system, but also provide the framework necessary to continue evaluating a custom-designed CMS in a cost effective manner.

### ***Research Questions***

The following four research questions were used to guide the study and interpretation of the results.

1. Which factors of usability influence the acceptance of the course management system by the users?
2. To what extent does experience with web-based learning systems and computer literacy influence the ratings of overall usability of the course management system?
3. To what extent does a student's computer literacy and experience with web-based learning systems influence the student's acceptance of the course management system?
4. Which of the existing course features are in need of improvement in terms of usability?

## **Methodology**

### ***Overview of Methodology***

This study was conducted using a survey instrument designed to gather data regarding (1) user's perceptions of usability, (2) demographic and background information, and (3) comments relevant to the course management system being studied. The survey data collected included responses to forty Likert-scale items, five demographic items, ten items relating to the users' experience with online learning, and four open-ended items.

### ***Sampling Method***

This convenience sample was obtained by making the online survey instrument available to users of the course management system after a successful login. This sampling method assured that respondents were current users of the course management system. During the time the survey was available, 735 students logged into the course management system. The overall response rate for the survey was 41.9%, which was above the average response rate for many electronic surveys (Cook, Heath, and Thompson, 2000). In an effort to achieve a high response rate, an incentive was offered for participating in the survey. Respondents were offered an opportunity to enter into a drawing for one of three gift certificates to an online retailer. All data was collected anonymously and participation in the study was voluntary. All participants were presented with a Letter of Informed Consent statement before taking part in the study.

### *Description of the Sample*

The survey used in this study was made available to all users of the IVC course management system including both students and instructors. During the four-week data collection period, 735 students accessed the course management system, from which 322 completed the survey. Of these 322 respondents, one respondent (0.3%) was a high school student, 13 (4%) were faculty or instructors, 45 (14%) were undergraduate students, and 263 (81.7%) were graduate students. The high frequency of graduate students represented in the sample was expected due to the focus of the IVC program on delivering graduate-level courses.

While the server side-programming of the survey instrument was designed to limit the survey to undergraduate and graduate students, the respondent that identified themselves as a high school student as well as those that identified themselves as faculty and instructors were removed from the dataset yielding a final sample of 308 respondents. It is possible that the respondents who were removed from the sample had incorrectly indicated their status, or that they were both an instructor in one course and a student in another course and identified their primary role differently than did the automated system.

The participants in this study were 308 undergraduate and graduate students currently taking courses via the course management system. 31.5% of the participants were male and 68.5% were female. Forty-five (14.6%) of the participants were undergraduates, while 263(85.4%) of the participants were graduate students. The mean age for the participants was 37 years old (SD = 10.3) while the median age was 36 years.

**Table 1: Academic Status of Respondents**

Academic status	N	%	Cumulative %
Freshman	0	0	0
Sophomore	9	2.9	2.9
Junior	9	2.9	5.8
Senior	19	6.2	12.0
Non-degree undergraduate	8	2.6	14.6
Non-degree graduate	29	9.4	24.0
Graduate	234	76.0	100

**Table 2: Gender Distribution of Respondents**

Gender	N	%
Female	211	68.5
Male	97	31.5

### ***Testing Instruments***

The survey instrument used in this study was a 55-item survey consisting of 5-point Likert scale items, demographic information, and open-ended questions and was administered in an online format through the course management system being studied. Survey pilot testing and expert validation were conducted during a related study by Lai (2004).

The 29 Likert scale items were positively worded statements and were recorded as: strongly agree=5, agree=4, neutral=3, disagree=2, strongly disagree=1. The survey also included 11 Likert scale items in which the respondents were asked to rate the ease of using specific course features available in the IVC courseware. These 11 items used a 5-point rating scale and also included an option to indicate that a course feature was not used by the participant. Additional data were also collected regarding the respondents' experience with web-based learning, proficiency with computer technology, and general demographic information such as age, gender, and academic status.

### **Internal Consistency of the Survey Instrument**

The internal consistency of the subscale measures on the survey was evaluated using a Cronbach alpha coefficient. The calculated alpha coefficient for all of the items in the survey was .96, indicating strong reliability for respondents similar to those in this study. For the items comprising each subscale, a coefficient alpha was calculated as well as a coefficient alpha for the subscale if each item were removed. As indicated in Table 3-5, the coefficient alpha values for each subscale measure were above the common minimum accepted value of .80 indicating that the subscales were generally consistent.

**Table 3: Survey Subscales and Reliability Analysis**

Subscale	Coefficient alpha	Survey Items
Ease of Navigation	.82	1, 2, 3, 4, 5
Consistency	.88	6, 7, 8, 9, 10
Ease of Learning	.83	11, 12, 13, 14, 15
Visual Perception	.87	16, 17, 18, 19, 20
Support	.94	21, 22, 23, 24, 25
Acceptance	.91	26, 27, 28, 29

## ***Procedures***

The survey was administered to the participants in an online format. In order to insure that the respondents were current users of the course management system, a link to the survey was visible to each user after they had logged into the system during their normal coursework. Participation was voluntary and the survey took approximately 15-20 minutes to complete. In order to encourage response to the survey, participants were offered an opportunity to enter into a drawing for one of three gift certificates to an online retailer. The survey system verified that the user had completed a successful login and was a current user of the course management system being evaluated, though no identifying user information was collected by the survey system. The online survey was designed to require responses to all Likert-scale items, but did not require responses to the open-ended items. After thorough testing prior to the survey release, no technical problems were reported by participants.

## **Results**

### ***Additional Respondent Demographics***

Data were collected regarding several different demographic dimensions of the respondents in order to identify characteristics relevant to participating in web-based and web-enhanced courses.

In terms of the availability of computers to the users, 15 (4.9%) indicated that they did not own a personal computer, while 293 (95.1%) indicated that they did own a personal computer. A slight majority of the respondents, 150 (58.7%), indicated that they most frequently used a broadband or faster Internet connection to access the CMS, while 142 (46.1%) reported using a dial-up Internet service. The remaining 16 respondents did not know the type of Internet connection they used most frequently.

With regards to users experience in taking courses online, or using a web-based course management system, 182 (59.1%) of the respondents reported that they had previously taken a course using the CMS being studied, while 126 (40.9%) were taking their first course that used the IVC system. The mean number of courses that the respondent reported taking using some type of course management system was three courses, while respondents indicating that they had taken two courses with a CMS was the most common response (N=70, 22.7%).

Respondents were asked to rate their level of computer literacy on a 5-point as being a beginner, novice, proficient, advanced, or expert. One respondent rated themselves as a beginner, 28 (9.1%) rated themselves as a novice, 173 (56.2%) rated as proficient, 89 (28.9%) rated as advanced, and 17 (5.5%) rated at the expert level.

### ***Responses to Subscale Items***

The Likert scale items which comprised the subscales for each usability factor were coded as follows: strongly agree=5, agree=4, neutral=3, disagree=2, strongly disagree=1. In all cases, a higher rating indicated a positive and more favorable response to the item. The highest mean rating among the subscale items was in response to the items "I would take another course that uses the IVC system" and "Background color and text color are easily distinguishable." The lowest mean ratings were in response to the item "The Help menu always has answers to my questions" followed by "I do not need instruction before I begin to use the courseware." With

the exception of items in the Support subscale, the mode for all of the items was 4, which indicated that the respondent marked the “agree” selection for those items. The mode for the items in the support subscale was 3, indicating that the users response was neutral.

**Table 4: Subscale Item Average Responses (n=308)**

	Mean	Mode	St. Dev.
<i>Ease of Navigation</i>			
1. I could easily select the content or section I want to view.	4.09	4	.85
2. I've never felt lost while using the on-line courseware.	3.31	4	1.23
3. Each page of this on-line courseware is clearly identified by the same logo/title/banner.	4.01	4	.83
4. I am always able to go easily back to the pages that I had previously visited.	3.65	4	1.05
5. The structure of this on-line courseware seems logical to me.	3.84	4	.88
<i>Consistency</i>			
6. I am satisfied with the courseware's use of color.	3.97	4	.69
7. The location of navigation buttons/links/menu is consistent across pages.	4.03	4	.73
8. The display format of content information is consistent.	4.02	4	.73
9. The title is clearly indicated on every page.	4.09	4	.64
10. Symbols/Icons for graphic data clearly represent the logo/title/banner/navigation buttons.	3.88	4	.80
<i>Ease of Learning</i>			
11. I do not need any instruction before I begin to use the courseware.	3.22	4	1.18
12. The content arrangement is reasonable for easy learning.	3.75	4	.91
13. I've found the various functions in this courseware are integrated.	3.67	4	.83
14. The order of menu options is logical.	3.93	4	.74
15. The names of menu/navigation buttons are accurate.	4.01	4	.731



	Mean	Mode	St. Dev.
<i>Visual Perception</i>			
16. Background color and text color are easily distinguishable.	4.12	4	.60
17. The course material is easy to read on the screen.	3.99	4	.78
18. Menus are distinct from other displayed information (e.g., content).	4.05	4	.69
19. Groups of information are well organized.	3.93	4	.83
20. I like the design of this on-line courseware.	3.75	4	.91
<i>Support</i>			
21. A HELP option is always accessible.	3.26	3	.83
22. The help instructions are easy to understand.	3.23	3	.80
23. Error messages are clear and useful.	3.24	3	.79
24. The Help menu always has answers to my questions.	3.05	3	.76
25. My questions are answered using one of the available Help options.	3.06	3	.76
<i>Acceptance</i>			
26. I am satisfied with the learning conditions.	3.83	4	.95
27. I am satisfied with the use of the IVC course system as a teaching resource.	3.84	4	1.03
28. The use of WWW courseware is effective for learning.	3.96	4	.92
29. I would take another course that uses the IVC course system.	4.12	4	.91

In order to compare the overall responses in the survey subscales, a total of all of the items for each subscale was calculated for each respondent. For each of the five usability factors, the maximum possible total score was 25 and the lowest possible score was 5. The mean total subscale value for consistency was the highest mean ( $\bar{X}=19.99$ ), followed by Visual Perception ( $\bar{X}=19.84$ ), Ease of Navigation ( $\bar{X}=18.90$ ), and Ease of Learning ( $\bar{X}=18.58$ ). The mean totals for the support subscales ( $\bar{X}=15.84$ ) was the lowest and also had the highest range. Since the acceptance subscale was comprised of only four items, the highest possible total was 20 and the lowest possible score was four. The mean total for the acceptance subscale, shown in Table 4-5, was 15.75. Because the subscale for acceptance was comprised of only four items,

this mean is not directly comparable to the mean totals for the five usability factor subscales. Among the six subscales, the subscales of support and acceptance received both the highest possible scores as well as the lowest possible total scores.

**Table 5: Descriptive Statistics for Usability Factor Subscale Totals**

Subscale	Mean	Max	Min	St. Dev.	Skewness	Kurtosis
Consistency	19.99	25*	10	2.98	-0.194	0.626
Ease of Learning	18.58	25*	10	3.423	-0.038	-0.092
Ease of Navigation	18.9	25*	8	3.731	-0.193	-0.375
Support	15.84	25*	5**	3.529	0.436	1.326
Visual Perception	19.84	25*	8	3.104	-0.266	0.668

\* indicates highest possible score

\*\* indicates lowest possible score

**Table 6: Descriptive Statistics for Acceptance Subscale Totals**

	Mean	Max	Min	St. Dev.	Skewness	Kurtosis
Acceptance*	15.75	20*	4**	3.396	-0.768	0.364

\* indicates highest possible score

\*\* indicates lowest possible score

### ***Usability Factors and Acceptance***

In order to determine the relationship between each of the usability factors and the measure of acceptance of the course management system, a correlation analysis was conducted which indicated that the mean values for all of the independent variables (Ease of Navigation, Design/Layout Consistency, Ease of Learning, Visual Perception, Support) were significantly and positively correlated with the dependent variable of Acceptance of the Online Courseware to varying degrees as indicated in Table 4-6. All correlations were determined to be significant at or above the .05 probability level and therefore were considered acceptable to be included in a multiple regression analysis used to determine the combined influence on acceptance.

**Table 7: Correlations Among Subscale Variables (N = 308)**

	Acceptance	Ease of Navigation	Consistency	Ease of Learning	Visual Perception
Ease of Navigation	.62**				
Consistency	.52**	.72**			
Ease of Learning	.64**	.76**	.68**		
Visual Perception	.63**	.75**	.79**	.72**	
Support	.41**	.52**	.43**	.54**	.48**

\*\* Correlation is significant ( $p < .01$ , 2-tailed)

The data to be used in the multiple regression analysis were examined for possible violations of several assumptions of a multiple regression analysis. The normality of both the independent and dependent variables was determined using the statistics of skewness and kurtosis. As indicated in Table 4-4 and 4-5, the values for skewness and kurtosis for all of the variables included in the study fell within the range of  $\pm 1.0$  indicating that the data are normally distributed. Scatter plots of the independent and dependent variables indicated that each independent variable exhibited a linear relationship with the dependent variable.

The preliminary multiple regression analysis indicated that independent variables Ease of Learning, Visual Perception, and Ease of Navigation were significant in the regression model and that ratings of Support and Design/Layout Consistency were not significant in the regression model. For this reason, a second multiple regression analysis was conducted to determine a more accurate regression model.

**Table 8: Preliminary Multiple Regression Analysis Using All Independent Variables**

<i>Variable</i>	B	SE	$\beta$	t	Sig.
Ease of Navigation	.239	.084	.210	2.833**	.005
Consistency	-.138	.101	-.097	-1.357	.176
Ease of Learning	.364	.088	.294	4.152**	.000
Perception	.438	.104	.321	4.198**	.000
Support	.031	.060	.032	.640	.523

Note: R Square = .483. Adjusted R Square = .474

\*\*p < .01

The multiple regression analysis using a backward model selection technique regressed Acceptance of the Online Courseware on Ease of Learning, Ease of Navigation, Visual Perception, Support, and Design/Layout Consistency. This analysis indicated that Ease of Learning, Visual Perception, and Ease of Navigation accounted for about 48% of the variance in Acceptance of the Online Courseware in the sample, ( $R^2 = .479$ ),  $F(3,304) = 93.14$ ,  $p < .001$ . Ease of Navigation was a significant predictor of Acceptance of the Online Courseware,  $t(304) = 2.72$ , and uniquely accounted for 1.3 % of the total variance in Acceptance of the Online Courseware ( $sr = .113$ ). Ease of Learning was determined to be a significant predictor of Acceptance of the Online Courseware,  $t(304) = 4.25$ , and uniquely accounted for 3.1% of the total variance in Acceptance ( $sr = .176$ ). Visual Perception was determined to be a significant predictor of Acceptance of the Online Courseware,  $t(304) = 4.11$ , and uniquely accounted for 2.9% of the total variance in Acceptance ( $sr = .170$ ).

**Table 9: Multiple Regression Model Using Backward Selection Technique**

<i>Variable</i>	B	SE	$\beta$	t	sr	Lower	Upper
Ease of Nav	.221	.081	.194	2.721**	.113	.061	.380
Ease of Learning	.362	.085	.292	4.250**	.176	.194	.530
Visual Perception	.374	.091	.273	4.108**	.170	.195	.553

R Square = .479. Adjusted R Square = .474

\*\*p < .01

The exclusion of Support and Design/Layout Consistency from the regression model using the backward model selection technique was expected based on the preliminary multiple regression analysis that indicated that these variables were not significant in the regression model. Further, the Adjusted R Square values shown in Table 4-9 for three regression models analyzed using the backward selection technique indicate that the exclusion of these variables did not alter the Adjusted R Square value for the regression model.

**Table 10: Comparison of Regression Models Using Backward Selection Technique**

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	R <sup>2</sup> Change
Support	.695	.483	.474	.483
Consistency				
Ease of Learning				
Ease of Navigation				
Visual Perception				
Consistency	.694	.482	.475	-.001
Ease of Learning				
Ease of Navigation				
Visual Perception				
Ease of Learning	.692	.479	.474	-.003
Ease of Navigation				
Visual Perception				

***Influence of Experience with Web-Based Course Management System and Computer Literacy on Overall Usability***

Both a correlation analysis among the variables and multiple regression analysis in which the overall usability ratings were regressed on the variables of experience with web-based course management systems and a self-rating of computer literacy indicated that there is no clearly identifiable relationship among these variables. A correlation analysis indicated that experience with course management systems did not have a significant correlation with usability ( $r=.09$ ,  $p=.125$ ). Similarly, the self-rating of computer literacy did not have a correlation with an overall usability rating ( $r=.07$ ,  $p=.245$ ). There was a positive and significant correlation between experience using a course management system and the computer literacy self-rating ( $r=.24$ ,  $p<.05$ ). While this correlation is statistically significant, it is considered to be a weak correlation.

The variables of experience with online learning systems, computer literacy self-rating, and overall usability were examined for possible violations of several assumptions of a multiple regression analysis. The normality of both the independent and dependent variables was determined using the statistics of skewness and kurtosis. As indicated in Table 4-10, the values for skewness and kurtosis for computer literacy self-rating and overall usability fell within the range of  $\pm 1.0$  indicating that the data are normally distributed. The data for experience with web-based learning systems as indicated by the number of courses taken using a web-based learning system were not normally distributed, thus increasing the possibility of underestimating the influence of this variable on overall usability.

**Table 11: Descriptive Statistics of Number of Courses Taken Using Web-Based Learning Systems, Computer Literacy Self-Rating, and Overall Usability Ratings**

Variable	Mean	Median	St. Dev.	Skewness	Kurtosis
Number of courses taken using web-based learning systems	2.88	2.0	2.45	1.57	3.71
Computer Literacy*	2.25	2.0	.377	-.207	-.576
Overall Usability**	108.90	108.0	16.58	.087	.116

\* 1=Beginner/novice, 2=proficient, 3=advanced/expert

\*\* Highest possible score =145, lowest possible score=29

**Table 12: Correlations Among Usability, Experience with Web-Based Course Management Systems, and Computer Literacy Self-Rating (N = 308)**

	Overall Usability	Experience using WBLS
Experience using WBLS	.09	
Computer Literacy	.07	.24*

\*Correlation is significant ( $p < .05$ , two-tailed)

A multiple regression analysis was performed to evaluate the influence of experience with course management systems and computer literacy on the ratings of overall usability. The overall regression model analysis indicated that the two independent variables were not significant predictors of usability ( $F=2.19$ ,  $p=.114$ ). Experience with web-based course management systems failed to be a significant predictor of usability ( $t=1.25$ ,  $p=.213$ ). Based on the correlation analysis, this result was as expected. The computer literacy self rating also failed to be a significant predictor of usability ( $t=1.41$ ,  $p=.158$ ).

**Table 13: Regression Model: Usability Regressed on Computer Literacy and Number of Courses Taken Using a Web-Based Course Management System (N=308)**

Variable	B	SE	$\beta$	t	p
Computer Literacy Self rating	2.211	1.563	.082	1.414	.158
Experience using WBLS	.330	.264	.072	1.249	.213

$R^2 = .014$

### *Influence of Experience with Web-Based Learning and Computer Literacy on Acceptance*

Both correlation and multiple regression analyses were also used to determine the influence of experience with web-based course management systems and computer literacy on a measure of acceptance. The correlation analysis indicated no significant relationship between the two predictor variables and acceptance. Experience with web-based course management systems did not have a significant correlation with acceptance ( $r=.07$ ,  $p=.246$ ). Computer literacy also did not have a significant relationship with the dependent variable of acceptance ( $r=.03$ ,  $p=.574$ ). As previously described, the two independent variables were determined to have a weak positive correlation that was statistically significant.

**Table 14: Correlations Among Independent and Dependent Variables (N=308)**

	Acceptance	Experience using WBLS
Experience using WBLS	.07	
Computer Literacy Self-Rating	.03	.24*

\*Correlation is significant at the 0.01 level (2-tailed).

The variables of experience with online learning systems, computer literacy self-rating, and acceptance were examined for possible violations of several assumptions of a multiple regression analysis. The normality of both the independent and dependent variables was determined using the statistics of skewness and kurtosis. The value for skewness and kurtosis for computer literacy self-rating and acceptance, as shown in Tables 4-10 and 4-5 respectively, fell within the range of  $\pm 1.0$  indicating that the data are normally distributed. The data for experience with web-based learning systems as indicated by the number of courses taken using a web-based learning system were not normally distributed, thus increasing the possibility of underestimating the influence of this variable on acceptance.

The lack of a significant influence by the independent variables on acceptance was further indicated by the multiple regression analysis. The measurement of acceptance was regressed on experience with web-based course management systems and computer literacy. This analysis indicated that the two independent variables failed to significantly predict acceptance ( $F=.718$ ,  $p=.488$ ). Based on the correlation analysis, this finding was expected, yet provides confirmation that the influence of experience using a web-based course management systems and computer literacy on acceptance is not significant in this sample.

**Table 15: Regression Model: Acceptance Regressed on Computer Literacy and Number of Courses Taken Using a Web-Based Course Management System (N=308)**

	B	SE	$\beta$	t	p
Computer Literacy Self rating	.082	.276	.017	.297	.767
Experience using WBLS	.058	.055	.062	1.058	.291

$R^2 = .005$

### *Examining Usability of Specific Course Features*

When examining the usability issues with specific course features, it was necessary to analyze both quantitative and qualitative data collected to fully address the research question. The first data analyzed were the ratings of ease of use of each course feature. Because these ratings also included an option for respondents to indicate that they had not used a feature, it is also possible to determine usage statistics for each course feature.

Table 4-19 includes the mean, standard deviation, and mode for each course feature. In terms of overall usage statistics, seven course features were used by more than 80% of the respondents. The course features that were used by the most respondents were the outline, login, and discussion boards. The course feature that received the highest ratings of ease of use was the login, followed by the announcements and outline.



**Table 16: Ratings of Ease of Use for Course Features**

	N	%	Mean (rank)	SD	Mode
Announcements	291	94.5	4.41 (2)	0.75	5
Outline	303	98.4	4.41 (2)	0.76	5
Discussion boards	299	97.1	3.93 (8)	1.17	5
Journals	253	82.1	4.00 (7)	1.06	5
Library	275	89.3	4.15 (6)	0.92	5
Portfolio	157	51.0	3.71 (11)	1.05	3
Drop Box	162	52.6	3.86 (10)	0.93	3/4 *
Grade Book	172	55.8	4.19 (5)	0.87	5
Login	300	97.4	4.56 (1)	0.71	5
Request Access	298	96.8	4.24 (4)	0.98	5
Password Recovery	150	48.7	3.87 (9)	1.03	5

\*multiple modes

There were also three course features that were not used by a large number of respondents. The password recovery, drop box, and grade book features were used by only 48.7%, 52.6%, and 55.8% of the respondents respectively. Two of these course features, the drop box and password recovery were also ranked among the bottom three in ease of use.

The open ended items on the survey were intended to provide additional information relevant to the usability of the course management system. Information was requested using a text entry field below the following questions:

- What were the most useful or attractive features of the website?
- When did the design of the website obstruct your learning?
- In terms of the interface design, what would have been better and in what way?
- Please list additional comments.

As indicated in Table 4-20, the largest number respondents described a problem with the discussion board feature (n=84). Ranking second in number of surveys that indicated a problem was the journal feature. Several common themes emerged from the description of usability

problems in these course features. Most notable among the comments was a general difficulty or confusion in navigating these course features. Further, there was a high occurrence of comments regarding the web server “timing out” during a posting to the discussion boards (n=32).

The grade book, password recovery, outline, and announcement course features were described as problematic on the fewest number of surveys. The grade book and password recovery features received no additional comments indicating any specific problems, while comments relating to the outline and announcement features were primarily concerning discrepancies with other course features.

**Table 17: Frequency of Surveys that Indicated a Problem with Each Course Feature**

	N	% of total	Common themes in problems described
Announcements	2	0.6	<ul style="list-style-type: none"> <li>• Announcements were not listed in appropriate order</li> <li>• Announcements appeared in multiple places</li> </ul>
Outline	1	0.3	<ul style="list-style-type: none"> <li>• Confusion regarding discrepancy between content in outline and other locations</li> </ul>
Discussion boards	84	27.3	<ul style="list-style-type: none"> <li>• Difficult/confusing to navigate</li> <li>• Server timeout during posting</li> <li>• Unclear icons/layout</li> </ul>
Journals	13	4.2	<ul style="list-style-type: none"> <li>• Difficult/confusing to navigate</li> <li>• Problems uploading file</li> <li>• Unclear icons/layout</li> </ul>
Library	6	1.9	<ul style="list-style-type: none"> <li>• Slow downloads</li> <li>• Navigation errors</li> </ul>
Portfolio	6	1.9	<ul style="list-style-type: none"> <li>• Uploading errors due to file size limit</li> <li>• Navigation errors</li> </ul>
Drop Box	3	1.0	<ul style="list-style-type: none"> <li>• Upload errors</li> </ul>
Login	5	1.6	<ul style="list-style-type: none"> <li>• Unclear on how to obtain username/password</li> <li>• Confusion with various UI user accounts</li> </ul>
Request Access	5	1.6	<ul style="list-style-type: none"> <li>• Difficulty locating course</li> <li>• Course inadvertently ended</li> </ul>
Instructor related	32	10.4	<ul style="list-style-type: none"> <li>• Poor communication with/by instructor</li> <li>• Lack of feedback/response</li> <li>• Poor instructor preparation</li> <li>• Lack of organization</li> </ul>

**Table 18: Comparisons in Rankings of Mean Ease of Use Ratings and Problems Identified by Open-Ended Items**

	Rank of mean Ease of Use rating	Rank of frequency of problems (fewest problems=1)
Announcements	2	4
Outline	2	3
Discussion boards	8	11
Journals	7	10
Library	6	8
Portfolio	11	8
Drop Box	10	5
Grade Book	5	1
Login	1	6
Request Access	4	6
Password Recovery	9	1
Announcements	2	4

## Conclusions and Discussion

### *Limitations of the Study*

One limitation that is inherent to this study is the inability to generalize these findings to similar web-based course management systems. While this inability to generalize is often viewed as a detriment to many studies, it is the specificity of these results that provides the valuable insight into users' perceptions that is required in order to determine specific facets of the software that are in need of redesign or modification. As demonstrated by Lai (2004), the survey instrument used in this study can be applied to different web-based course management systems. Using these results, however, it is not possible to make a comparison in quality of the course management system. It is likely, however, that the evaluation strategy used could yield similar information relevant to the improvement of other course management software products.

A second limitation of this study is a result of the rate of response to the survey. While the 41.9% response rate is slightly above the average response rate to electronic surveys as indicated by Cook et al. (2000), the sample is less than a majority of the active users during the survey period and may not accurately represent the population of users. Even with responses

from less than a majority of active users, however, the indications of common problems encountered by the users does provide valuable and accurate information that will assist in the improvement of the software. Though it is possible that the problems identified do not fully account for all of the problems that are commonly encountered, those issues that have been identified can now be addressed regardless of the response rate.

### *Predicting Acceptance*

The findings of this study indicate that three of the five usability factors are significant in predicting approximately 47% of the variance in acceptance of the online courseware. The combination of ease of navigation, ease of learning, and visual perception together positively influence the acceptance of the online courseware. However, because only three of the five factors that were theorized to influence acceptance were found to be significant in the regression model, it is important to note that the list of usability factors relevant to user acceptance will require refining in the future. Also, the data indicate that there is a high degree of redundancy in the regression model since each of the three significant usability factors uniquely accounts for only a small portion of the variance explained by the complete regression model. Based on this redundancy, it is possible that one of the three usability factors, either ease of learning, ease of navigation, or visual perception, is inclusive of the other two constructs.

**Table 19: Unique Variance in Acceptance Predicted by Usability Factors**

Usability factor	Semi-partial correlation	Unique variance in acceptance
Ease of Navigation	.113	1.28%
Ease of Learning	.176	2.82%
Visual Perception	.170	2.89%

The identification of the redundant nature of the three significant predictor variables provides valuable information when further refining the survey instrument for future evaluations of the course management system. It cannot be determined from this study whether these three usability factors are separate constructs or whether they comprise a single attribute of usability. Based on the types of questions in each subscale, it is possible that the measure of ease of learning is inclusive of both ease of navigation and visual perception. If this is the case, then a software product that is rated high on ease of navigation and visual perception would also be rated high in ease of learning.

While the relationship among the variables that were determined to be predictors of acceptance in the sample is important, it is also relevant to consider the two variables that were not significant in the regression model. Both consistency and support were noted in some manner in all descriptions of usability factors. The question arises, then, of why these two variables did not prove to have a relationship beyond a correlation with the dependent variable of acceptance. The correlation between consistency and acceptance was positive and significant, but weak ( $r=.52$ ). The support subscale also had a significant and positive correlation with acceptance, as well as the other independent variables. However, the correlation between

support and acceptance was also weak ( $r=.41$ ). Because these were among the lowest of all of the correlations with acceptance, it is possible that these factors do not directly influence acceptance, but perhaps influence other aspects of a user's perception of the software that were not included in this study.

With respect to support specifically, one notable characteristic of the data is that the five items comprising the subscale of support received mean responses that were among the lowest of all of the Likert-scale items. The implications of this data are somewhat unclear. One possibility is that as the perceived support decreases, its influence on acceptance decreases as well. It is also possible that the support subscale items did not accurately measure support. Because the support subscale items referred to "help instructions" and a "Help menu" that are not currently a part of the IVCMS, the failure of these items to accurately account for the type of support provided is likely. However, the relationship between support and acceptance does warrant further research to both clarify the support subscale and also to more accurately define a possible relationship with acceptance.

In terms of improving the design of the IVCMS, the results of the regression analysis point out the importance of ease of learning, ease of navigation, and visual perception. In its current state, the IVC course management system has proven to be accepted for its intended purpose due to its ease of use, ease of navigation, and the overall visual perception. The factors of support and consistency do not appear to positively or negatively impact the acceptance of the system. Based on this analysis, the future design of the course system should focus on making the system easier to learn, easier to navigate, and visually appealing. It is important to note that, though the factors of support and consistency were not found to significantly contribute to acceptance, these factors should not be ignored in the future. The lack of a significant contribution to the regression model simply indicates that they do not appear to contribute to acceptance of the system. It is possible that these factors contribute to other areas of the overall user experience such as users' perception of the quality of the online courses, etc.

In examining the data to determine the capabilities of the survey as an evaluation instrument, the analyses indicate that the subscale items are reasonably capable of predicting acceptance of the online courseware. However, further research will be required to refine the survey instrument to eliminate redundancy in the subscale measures and increase the overall usefulness of the instrument as an evaluation method. It will be necessary, however, to further clarify some of the subscale items on the survey instrument. The redundancy of ease of learning, ease of navigation, and visual perception indicates that these items could be combined in the survey to comprise a single subscale. As such, the length of the survey instrument could be reduced and some of the items eliminated.

One clear indication from this analysis is that acceptance is influenced by factors not included in this survey. Because ease of learning, ease of navigation, and visual perception accounted for 47% of the variance in acceptance, it is possible that the perceived usefulness of the system would account for a portion of the remaining 53% of the variance.

### ***Impact of Computer Literacy and Experience with Web-Based Learning Environments***

In examining the impact of computer literacy and experience with web-based learning environments on both usability and acceptance of the course management system, it was necessary to conduct two separate analyses due to the high correlation between usability and acceptance. It was also necessary to include computer literacy and experience with web-based learning environments in both analyses because these two factors are somewhat related, thus the

possibility for an interaction effect is great.

The analysis of the influence of computer literacy and experience with web-based learning environments on usability indicated that there were no significant differences among the mean usability ratings of the web-based courseware. From this analysis, it can be concluded that the overall usability of the system is similar for users with differing levels of computer literacy and experience with web-based learning systems. With respect to the design of the course management system, the results of this analysis are positive. For a web-based course management system to be effective, it must be easy to use from the beginning. Thus, of primary importance are the users who are new to this or other course management systems and also those users with limited experience using computer technology. Because the survey was administered at the mid-point of the semester, it is possible to conclude that users can achieve an acceptable level of proficiency with the system within the first 6-8 weeks of using the system.

The results of this analysis further reveal a limitation of the survey instrument. Since the survey could only be administered once during the semester, it is impossible to identify the nature of the learning required to successfully use the course management system. For example, it cannot be determined if the usability of the system was high from the beginning for new users or if learning to use the software required more significant time and effort. As such, there is a limitation on what can be concluded from this analysis. It would be beneficial to understand the nature of the learning curve of the software for different types of users. This, however, is not possible with a one-time survey. Additional usability evaluation methods might be more capable in understanding how new users learn to use the system for during their early experience with the software.

### *Improving Existing Features*

The information gathered by studying the ease of use and problems encountered with specific features will likely have the most direct impact on the future design of the course management system as well as the future refinement of the survey instrument. While looking solely at the ease of use ratings of the course features does provide some insight into user perceptions of each course feature, there is not a clear indication of which course features are in most need of redesign, nor is there any clear indication of what type of redesign might improve the usability of the features. For example, the drop box and the portfolio course features ranked as the two features with the lowest mean ease of use rating. However, these two features were also among the least used. Based on this information, a number of possible explanations exist. For example, the low usage of these features might be caused by the difficulty in use. However, the low mean ease of use rating could be influenced by the low usage. Even with the various possibilities, it should be noted that all of the course features received ratings above the scale midpoint. Also, with the exception of the portfolio and drop box features, the statistical mode rating for each feature was a rating of “very easy.”

A more informative statistic in the ratings of ease of use is the variance for each mean rating. Since a higher variance would indicate a wider distribution of ratings of ease of use, this statistic would also indicate a higher level of disagreement among the respondents in their ratings. The discussion board feature has the highest variance ( $s^2=1.37$ ), followed by the journal ( $s^2=1.12$ ) and the portfolio ( $s^2=1.10$ ) features indicating that the ratings of the ease of use of these course features were most broadly distributed. However, using this statistic alone does not present a clear and understandable picture of the ease of use of each feature due to the difference

in usage of the features. In examining the mean ratings of those features with higher usage, it would be expected that the variance were also higher simply based on the higher numbers of respondents. In general, the Likert-scale items provide a picture that is incomplete and difficult to interpret in a manner that would provide insight for future improvement of the course management system. These ratings simply raise new questions rather than addressing the questions posed in this study.

Based on the Likert-scale items alone, it is difficult to make any meaningful conclusions about the use other than the number of respondents who reported using each course feature, and in some cases, even this usage information is questionable. For example, only 300 of the 308 respondents reported using the “Login” feature. Clearly there is some sort of a misunderstanding with this item. In this specific example, use of the login feature was required in order to complete the survey used in this study and is also the first step in accessing an online course. There are no options for accessing either the survey used in this study or the course management system without using the login feature. As such, the number of respondents reporting that they had used the “Login” feature should have been equal to the total number of respondents.

In contrast to the ease of use statistics, the results of the content analysis of the open ended items provides a more informative representation of which course features are in most need of redesign and revision. Based on the content analysis, the discussion board feature received the most comments that indicated a problem during use. However, the types of problems encountered and reported by the users were relatively uniform, indicating that the problems were largely due to a lost connection with the web server, problems with navigation, and unclear iconography. Because the discussion boards were also among the most used course features and one in which the user was engaged in an interactive manner, the high occurrence of problems might be simply a factor of the high usage. However, the indication of specific and recurring problems provides the foundation for the redesign of this course feature. Based on the content analysis, there is clearly a need to address the problem of server timeouts as well as the need to clarify or simplify the navigation in the discussion board system.

In comparing the two methods of collecting information relevant to the improvement of specific course features, it appears that more valuable information was provided through the open-ended items than was provided by the Likert-scale items. From the information provided by the open-ended items, it is possible to clearly identify problems that exist. From the Likert-scale items, no such judgments could be made. The most informative information collected via the Likert-scale items was usage statistics for each feature. Based on the information provided in this study, it would be beneficial to redesign the survey instrument to include open-ended items relating to each feature.

### ***Summary of Study and Findings***

In evaluating the custom-built course management system, this study sought to provide information by which improvements in the system design could be planned and also to develop the means by which future evaluations could be conducted. In order to accomplish these goals, it was necessary to research users’ perceptions of the course management system and to determine the influence of user characteristics on these perceptions. By focusing on factors that comprise usability and their relationship with users’ acceptance of the course management system, it was possible to (1) identify specific issues that exist in the current design of the software, and (2) provide empirical data relevant to the improvement of the survey instrument used in this study.

Several specific usability issues were identified in the current design of the course

management system. Discovered largely as a result of the content analysis of the open-ended survey items, issues such as confusing interface design and the commonly encountered problem of “server timeouts” when using the discussion boards have been identified during the evaluation and account for a large number of the problems noted by participants. While several existing problems were identified, the usability of the course management system is above average in all measured categories. The overall indication from this study is that the usability of the course management system is acceptable, but improvements can be made that will likely increase the ratings of usability and possibly eliminate a large number of commonly occurring problems.

This research, together with a study by Lai (2004), are the beginning steps in the development of the survey instrument used in this study. As such, the results of this study indicate that the survey instrument is capable of providing data relevant to the evaluation of a course management system, though it is certainly in need of future revision in order to address the issues of redundancy and the need to more closely match the software being evaluated. Further, the method for administering the survey was found to be acceptable, though also in need of improvement in order to increase the response rate to better account for a majority of users of the course management system.

### ***Recommendations for Future Research***

Based on the results of this study, future research concerning the web-based course management system being evaluated should focus on refining the survey instrument to eliminate possible redundancy and better serve its purpose as a tool for evaluation of the online courseware. It is likely that the redundancy in the instrument that was identified in this study was indicative of factors that were thought to be separate constructs are part of one or more global constructs.

It is also recommended that future studies of this nature continue to seek evaluation methods that blend the efficiency of survey methodologies with the richness of the information that can be gained through narrative data. While the open-ended items included in the survey used in this study provided valuable insight into the perceptions of the course management system, it is possible that the use of structured interviews as a follow-up to a survey would provide a means by which common problems and perceptions could be verified and also would provide possible insight into the most effective means of correcting the problems.

In addition to the refining of the survey instruments and evaluation methodologies, further research would also benefit by examining other possible influences on usability, such as instructor technical assistance, pre-existing attitudes toward online learning, prior experience with other course management systems, and the interaction of course content with the overall usability of the CMS.

As was demonstrated in this study, the goal of future research of this nature should be clearly focused on the improvement of web-based course delivery systems. There are, however, two sides to the evaluation of a web-based course delivery system. One side seeks to identify factors that inhibit the teaching and learning process, while the other side seeks to understand factors that enable the teaching and learning process. While it is possible to study these two sides separately, it is recommended that future research begin to expand towards identifying features of the web-based course delivery system that can better enable the teaching and learning while continuing to identify possible inhibitors as well.



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