Usability of Course Management Systems by Students

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Abstract

Industry experts estimate that 90% of higher education institutions use course management systems (CMS) to assist in delivering content to students, either as supplements to courses delivered face-to-face or as an entire course offered online (Green, 2006). A key factor in students and instructors adopting the technology is the ease-of-use of the course management system. Our study conducted usability testing on three CMS: WebCT, Sakai and Moodle. Usability was measured from the perspective of a student using the system for the first time. Results identified problems with navigation, both placement and naming issues, and non-standard interface behaviors.

Introduction

Academic institutions rely heavily on technology to assist in course delivery, predominantly through the use of course management systems (CMS). Course management systems, otherwise known as learning management systems or virtual learning environments, provide instructors a set of tools to manage course content and student progress. They are most often used to supplement face-to-face courses but are also used as the primary means of delivering courses online, or via distance learning. The tools provided in a CMS allow instructors to post course content, grade student submissions, and monitor student progress. Student tools allow them to submit assignments, to interact with others through discussion forums, take quizzes and surveys, and review content. Some systems come with additional features, such as the ability to store files on the CMS server, create a wiki, work in groups, create student portfolios and many others.

This usability study attempts to address the question of how easy the CMS is to use. Of concern is the capability of the CMS to detract from the students ability to learn course material. The easier the CMS is to use, the faster the student will be able to focus on the content and activities. The more frustrated a user becomes with a system, the more likely they are to disengage from the task at hand, either abandoning it completely or spending an inordinate amount of time "figuring it out."

The usability study conducted is in its first phase, examining the perspective of a student using a CMS for the first time. Future phases will include studies from the instructor's and course developer's perspectives as well as long-term usability and satisfaction with the system. Results of the studies will be used to form a set of guidelines, or heuristics that CMS usability can be evaluated against as well as used by institutions and individuals considering adopting a course management system.

Background

What is usability? Usability is part of the larger field of human-computer interaction, which is an interdisciplinary field comprised of computer science and others such as psychology. Jakob Nielsen (1993) broke usability down into the following components, or characteristics that a usable system should have:

- Learnability – easy to learn so that the user can rapidly start doing work
- Efficiency – once it is learned, the user can complete their tasks quickly, achieving a high level of productivity
- Memorability – the user should be able to return to the system after a time and not have to learn it all over again

- Errors – users should make few errors and if there is an error, they should be able to easily recover from it
- Satisfaction – users should be satisfied when using the system, i.e. that it's enjoyable to use

Usability testing attempts to discover any issues users may have with those aspects of the system. There are many forms of assessing a system's usability, including expert review, heuristic evaluation, cognitive walkthroughs, task analysis, and ethnographic study/participant observation. The most fundamental method, however, is usability testing for gathering direct information from the user's experience with the system. A usability test consists of "One-on-one sessions where a "real-life" user performs tasks on the Web site in order to identify user frustrations and problems with the site" (Usability.gov, p. 11). This testing identifies mistakes users make when using the system and can provide a wide range of feedback from design choices such as layout and font to editorial choices such as naming conventions. The value of this method comes in direct observation of a user as they use the system, instead of examining a system based on a list of guidelines, as is done in heuristic evaluation and expert reviews.

Methods

The usability study was conducted because of the need for more usability information on course management systems. While there is much in the literature on the usability of web sites and the usability of software systems, there is little that looks at systems implemented over the web, nor is the information specific to course management systems. The usability study consisted of the following 8 steps to prepare, conduct and analyze the study and its results.

1. Three course management systems were identified: WebCT Campus Edition 6.0, Moodle 1.6.2 and Sakai 2.2.2 (demo version). The first was chosen because it was implemented in a test environment at the college and the other two because they are open-source software and therefore freely available. Moodle and Sakai were then installed on local servers. No customization beyond that necessary to identify the site was used. Only the demo version of Sakai was used as well.

2. Eight tasks were then identified to test during the study. The tasks were chosen to be representative of the activities a student would be asked to undertake in an online course during the first week of class. The first week of class was chosen as subsequent weeks would imply a familiarity with the system that our participants would not possess. Tasks were chosen based on the scenario that this was their first week of class and they needed to familiarize themselves with the course (syllabus, content) and the CMS tools (calendar, discussion board, quiz and assignment).

Tasks:

a. Login
b. Find and review course syllabus
c. Review course calendar
d. Introduce yourself on the course discussion board
e. Review course content and download a file
f. Complete first week's quiz*
g. Upload file and submit it for first week's assignment
h. Logout

**Not available in the demo version of Sakai*

3. A sample course was created in each CMS with a syllabus, a learning module, an assignment, a quiz and a discussion board posting. The course content was consistent across all courses and every attempt was made to keep all the courses from diverging. Figures 1, 2 and 3 show the initial user interface after students had logged in and selected the course, which will be referred to as the course home page.

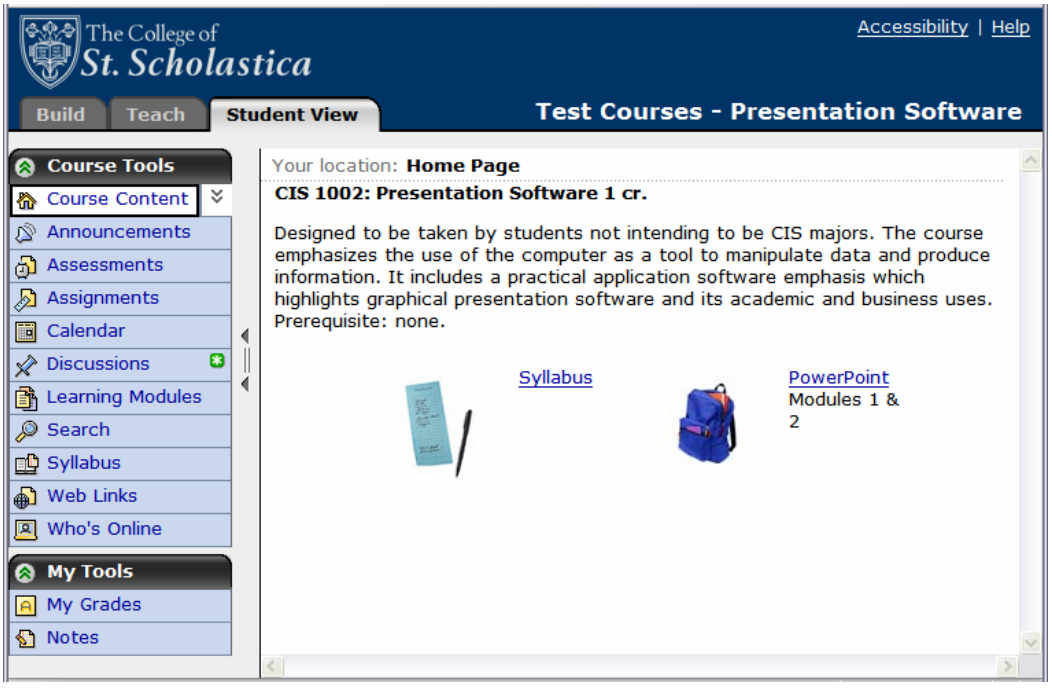

Figure 1: WebCT 6.0 Course Home Page

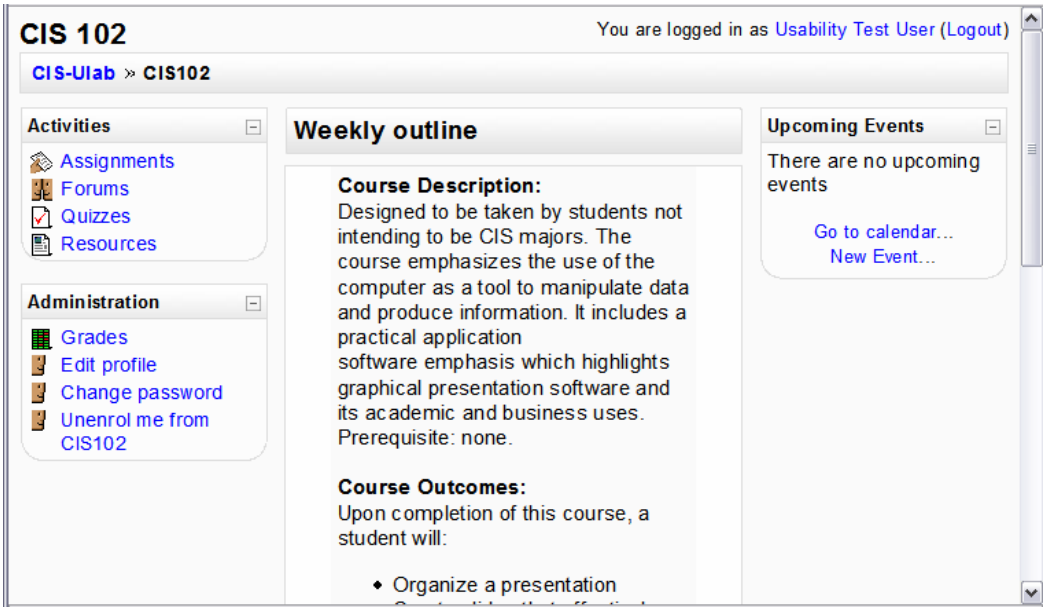

Figure 2: Moodle Course Home Page

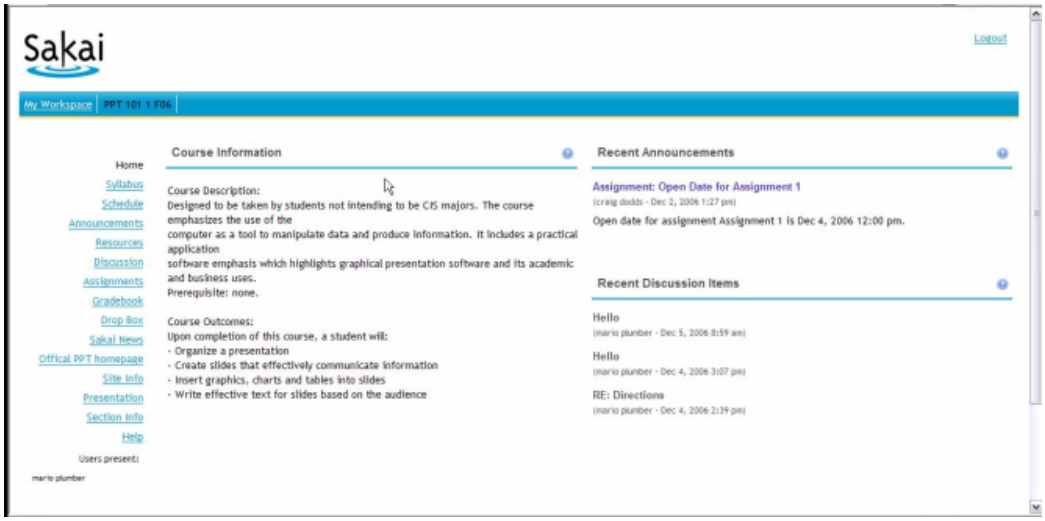

Figure 3: Sakai Course Home Page

4. Documentation for the usability test was prepared and consisted of the following:

    a. Study Overview: Summary of the usability process and how the results from testing would be to be given to participants to read. Also included was a paragraph outlining their intended role as a student taking this course during the first week of class.

    b. Consent Form: The recommended videotape consent form from the Usability.gov website was used (U.S. Department of Health, n.d.). It contained information on privacy and other rights the participants have as well as who is conducting the study.

c. User Profile Survey: The survey asked the participants to supply their background, demographic information as well as their experience with course management systems, including the three being studied. It also asked them to indicate their experience levels with computers.

d. Moderator Checklist: The checklist was essentially a script for the moderator to follow during the test session, ensuring that all participants were given the same information in identical order.

e. Participant Written Instructions: The list of tasks and specific directions for each task for the user to follow during testing. For example, the participants were instructed to find the discussion board, read the message posted and reply with the paragraph of text provided and then return to the course home page.

f. Post-Test Survey: The survey contained a questionnaire for the participants to fill out upon completion of the usability test. The System Usability Scale (SUS) was chosen as it was shown to be the most accurate for the fewest number of participants in website analysis by Tullis and Stetson's study (2004). Although Nielsen (2000) suggests that five users are sufficient to find 80% of usability problems on a site, the SUS survey is most accurate with at least 12 users (Tullis, et al., 2004). The questions in the survey were modified to be specific for course management systems and are listed below. Two additional questions were added to provide users an opportunity for open-ended feedback (#11 and 12). All other questions were ranked on a scale from 1 – 5 where 1 was Strongly Disagree and 5 was Strongly Agree.

1) I think I would like to use this CMS frequently.
2) I found the CMS unnecessarily complex.
3) I thought the CMS was easy to use.
4) I think I would need Tech Support to be able to use this CMS.
5) I found the various functions in this CMS were integrated.
6) I thought there was too much inconsistency in this CMS.
7) I would imagine that most people would learn to use this CMS very quickly.
8) I found the CMS very cumbersome to use.
9) I felt very confidents using this CMS.
10) I need to learn a lot about this CMS before I could use it.
11) What aspects of the CMS did you find satisfactory and why?
12) What aspects of the CMS did you find unsatisfactory and why?

5. Approval from the Institutional Review Board was sought and granted to conduct a test using human subjects.

6. Participants were recruited to conduct the usability test and consisted of undergraduate students from the college. In each case, extra credit points were given to students taking part in the study. However, it was strictly voluntary for students to participate or not to participate in the study. Of the 42 participants recruited, each was randomly assigned to a single CMS. However, if during the profile survey they indicated experience with the CMS they were being asked to evaluate, they were randomly assigned to another CMS. All data was coded with a randomly generated unique ID so as not to identify individuals.

7. Testing was conducted by recording the user's interaction with the CMS through the use of TechSmith's Morae software. The software uses rich recording technology to record not only the screen, but also the input from mouse and keyboard, window events (such as open and close), and other application events (www.techsmith.com). In addition, the user's face and audio was recorded for analysis. Testing was conducted in an office or meeting room setting with only the participant and the moderator present. A laptop with an Internet connection, an external mouse, and a web camera was provided. Participants used Internet Explorer 6.0 as their browser to view the CMS.

8. Recordings and survey data were analyzed for the following quantitative usability metrics in three categories:
    1) Effectiveness
        a. Error Rate – number of errors per participant
        b. Assist Rate – number of assists per participant
        c. Unassisted Completion Rate – Percent of participants who completely and correctly achieve task without assistance from the moderator
        d. Assisted Completion Rate – Percent of participants who completely and correctly achieve task with assistance from the moderator
        e. Documentation Rate – number of times participants access the system's help files
    2) Efficiency
        a. Mean, range and standard deviation of time to achieve task
        b. Completion rate/Mean time
    3) Satisfaction
        a. As measured by a modified System Usability Scale (SUS)

    Each recording was also analyzed qualitatively for information on where users were not able to immediately complete the task and especially where they needed assistance. The results were examined using affinity analysis, grouping issues into excusive categories that suggested general problems as outlined by Barnum (2002) in *Usability Testing and Research.*

Results & Discussion

The usability study resulted in the analysis of data indicating how students interact with course management systems as well as best and worst practices. Forty-two participants were recruited, all of them undergraduate students at the college. The demographic breakdown of gender and age for each CMS is shown in Table 1.

	Moodle *n=13*	Sakai *n=13*	WebCT *n=16*	Total *n=42*
Gender				
Male	5	9	9	23
Female	8	4	7	19
Age				
18-24	13	12	14	39
25-34	0	1	2	3

Table 1: Demographic Data

None of the users had previous experience with the system they were being tested on; however, almost all had experience using some type of CMS – most predominantly WebCT 4.1, as shown in Figures 4 and 5. It should be emphasized, however, that the interface changed significantly in WebCT from version 4.1 to 6.0, with few similarities from the students' perspective.

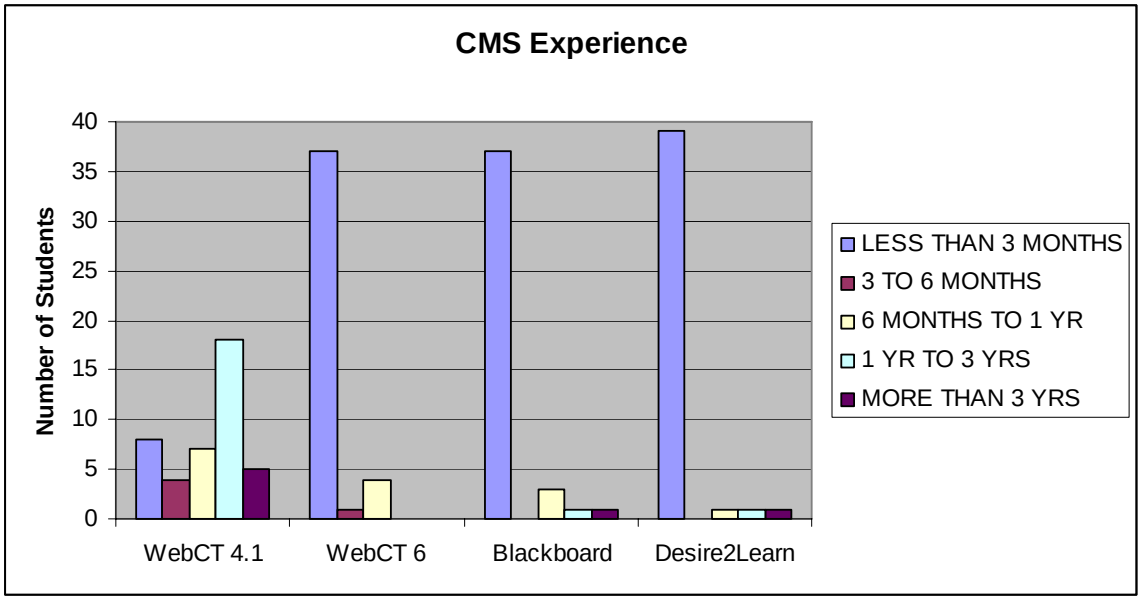

Figure 4: CMS Experience

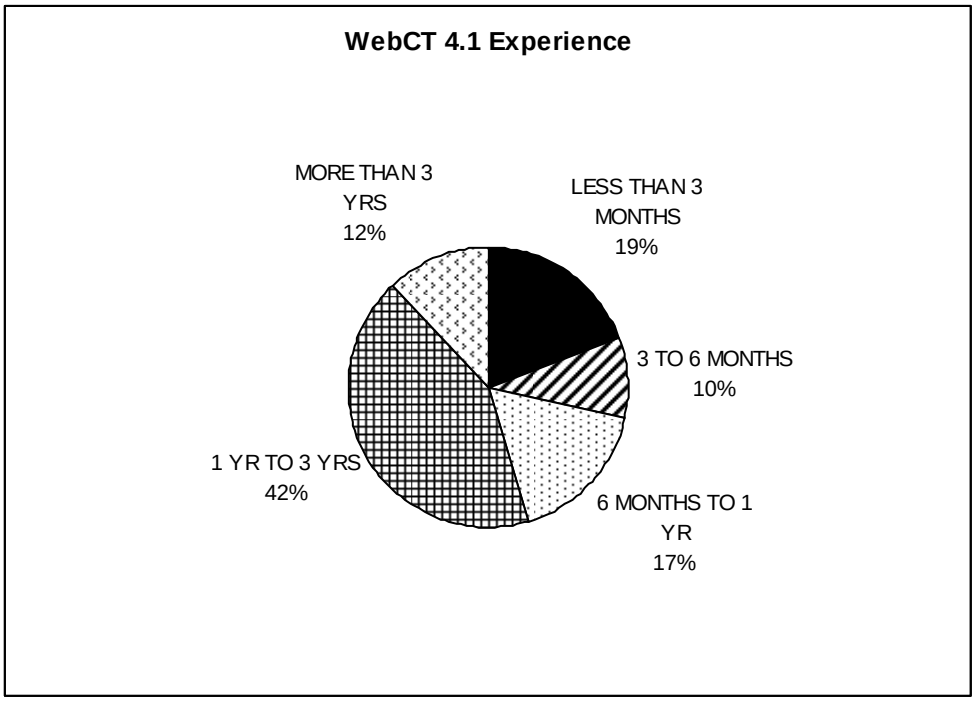

Figure 5: WebCT 4.1 Experience

Quantitative

Effectiveness

Effectiveness is the measure of how successfully a user can complete a task within the system. It is measured by the error rate, unassisted completion rate and assisted completion rate. The error rate is the percentage of users who were unable to complete the task, or had to attempt portions of the task more than once. The unassisted completion rate is the percentage of users who were able to complete the task without intervention from the test moderator. As you can see from the data in Table 2, the easiest tasks for users across all CMS were logging in and out and finding the syllabus. On all other tasks, a significant number of users needed assistance. Specific tasks and CMS that users struggled with (error rates > 25%) were posting a discussion message in Moodle and WebCT, reviewing content in all CMS, taking the quiz in WebCT and submitting the assignment in Moodle.

		CMS		
Task Data		**Moodle**	**Sakai**	**WebCT**
Login	Error Rate	0%	8%	0%
	Unassisted Completion Rate	100%	92%	100%
Review Syllabus	Error Rate	8%	0%	7%
	Unassisted Completion Rate	92%	100%	93%
Review Calendar	Error Rate	17%	23%	20%
	Unassisted Completion Rate	83%	77%	80%
Discussion Posting	Error Rate	75%	15%	27%

	Unassisted Completion Rate	25%	85%	73%
Review Content	Error Rate	50%	69%	47%
	Unassisted Completion Rate	50%	31%	53%
Take Quiz	Error Rate	0%	-	33%
	Unassisted Completion Rate	100%	-	60%
Submit Assignment	Error Rate	25%	8%	7%
	Unassisted Completion Rate	75%	92%	93%
Logout	Error Rate	0%	0%	0%
	Unassisted Completion Rate	100%	100%	100%

Table 2: Errors and Assists

The assisted completion rate for all tasks on all systems was 100%, meaning that all students were able to complete the tasks when provided with assistance from the test moderator. The assist rate measured how many times users needed assistance on each task. For example, a user might need help finding the link to the assignments and then need help later in submitting the assignment file, re Sakai users actually had the fewest number of assists per task per user whereas WebCT had the highest assist rate, suggesting that tasks were still confusing even with assistance.

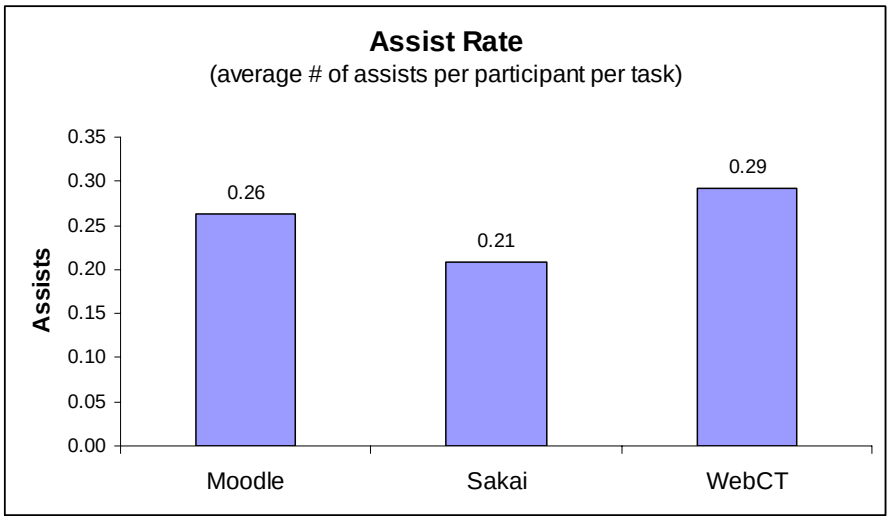

Figure 6: Assist Rate per Task

Efficiency

Efficiency relates the level of effectiveness to the quantity of resources expended, where resources are generally considered to be the amount of time taken to complete the task. Table 3 gives the time on task figures for each task by CMS and a comparison of the mean values are depicted in Figure 7. While the effectiveness measures given earlier indicated where some trouble areas were, this data shows how difficult (i.e. how much time) it was to complete the tasks. In general, the more users needed help, the more time they required on the task. So, the same tasks that were issues above were also the most inefficient, taking the longest to complete.

Task		CMS		
		Moodle	**Sakai**	**WebCT**
Login	Mean	42.3 ± 24.1	48.4 ± 21.1	33.1 ± 15.3
	Range	(12.5, 92.0)	(21.7, 95.8)	(17.5, 63.5)
Review Syllabus	Mean	16.6 ± 15.5	16.7 ± 14.4	9.4 ± 11.0
	Range	(1.5, 41.5)	(3.7, 49.7)	(1.5, 44.0)
Review Calendar	Mean	21.3 ± 18.3	21.8 ± 14.6	13.5 ± 9.6
	Range	(5.5, 63.5)	(2.6, 50.0)	(3.0, 42.5)
Discussion Posting	Mean	66.0 ± 33.8	35.8 ± 48.4	29.1 ± 20.2
	Range	(26.6, 162.4)	(9.2, 144.8)	(10.5, 75.2)
Review Content	Mean	65.5 ± 28.9	131.7 ± 57.8	68.5 ± 35.2
	Range	(26.1, 131.8)	(68.1, 255.3)	(34.0, 140.5)
Take Quiz	Mean	15.7 ± 5.7	-	52.1 ± 45.2
	Range	(10.4, 30.3)	-	(15.4, 204.0)
Submit Assignment	Mean	50.5 ± 23.9	85.9 ± 28.2	83.2 ± 22.7
	Range	(29.0, 100.5)	(46.1, 139.9)	(52.0, 119.9)
Logout	Mean	4.2 ± 0.9	5.1 ± 3.1	4.2 ± 1.9
	Range	(3.0, 6.0)	(1.1, 12.1)	(2.0, 8.5)

Table 3: Time on Task (in seconds)

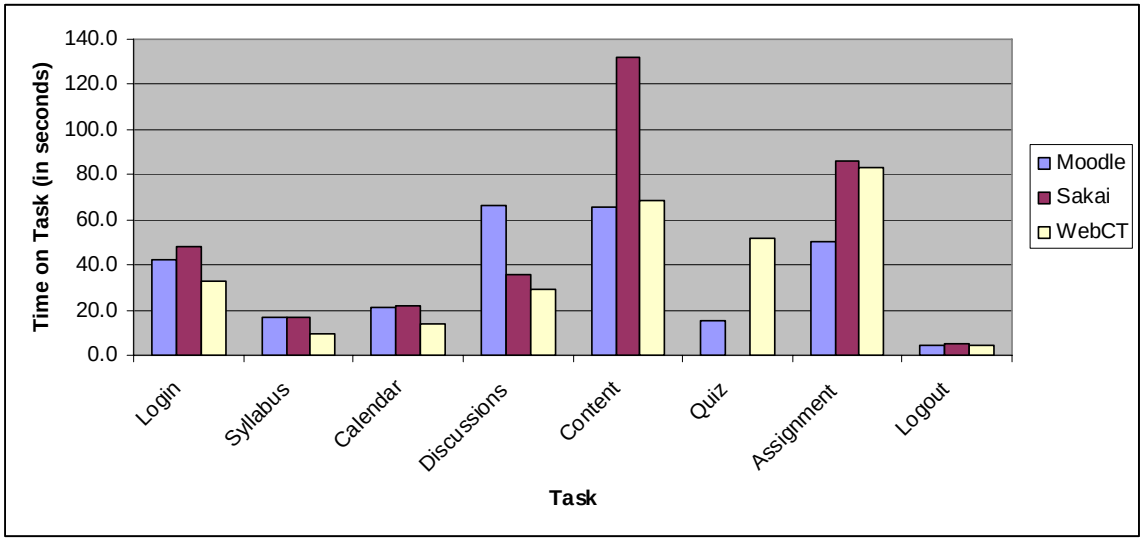

Figure 7: Mean Time on Task

The core measure of efficiency, however, is the completion rate/mean time which specifies the percentage of users who were successful for every unit of time. As time on task decreases, you would expect users to be more successful, which is evident with the last task: logging out. Logging out had the lowest time on task values and the highest completion rates and so is the most efficient task. The least efficient task was finding content, primarily because there is not a good way to name and organize content in any of the course management systems.

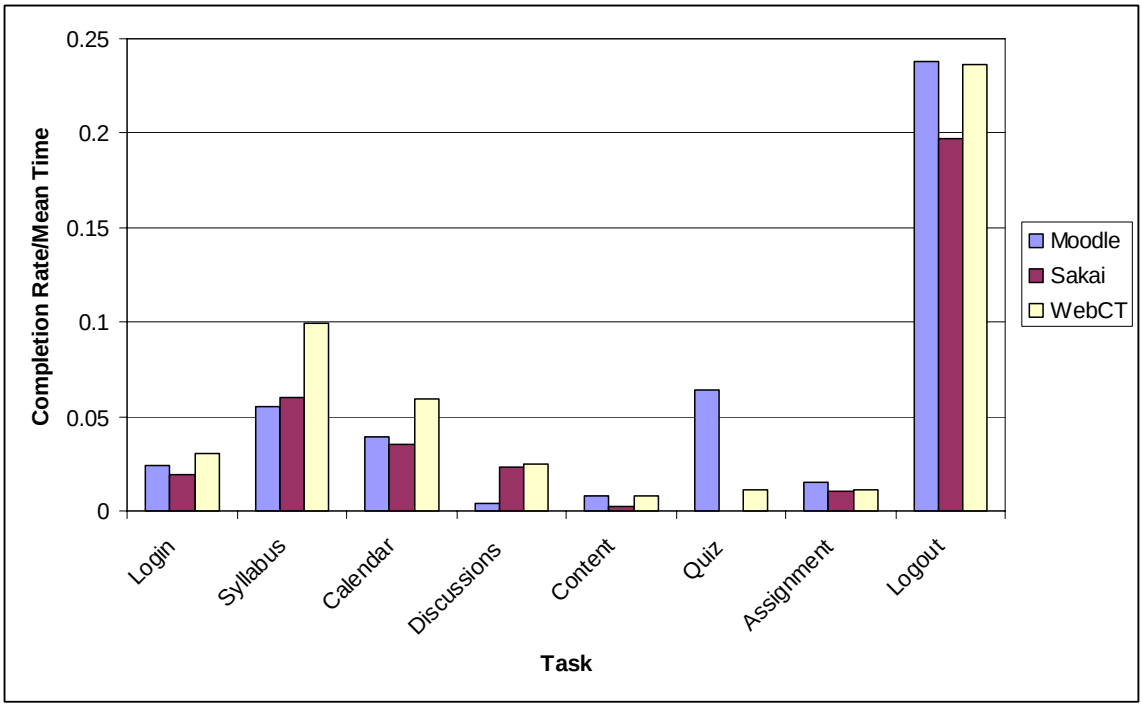

Figure 8: Completion Rate/Mean Time

Satisfaction

This describes a user's personal, subjective response when using the course management system. User satisfaction may be an important correlate of motivation to use a product and may affect performance in some cases. For example, if a user is highly dissatisfied with the system, they may give up on a task sooner than if they were highly satisfied. The SUS questionnaire was scored according to the procedure outlined by Brooke (1996). The scores displayed in Figure 9 indicate that WebCT had the highest satisfaction of the systems. Table 4 provides the quartile ranges for the SUS scores.

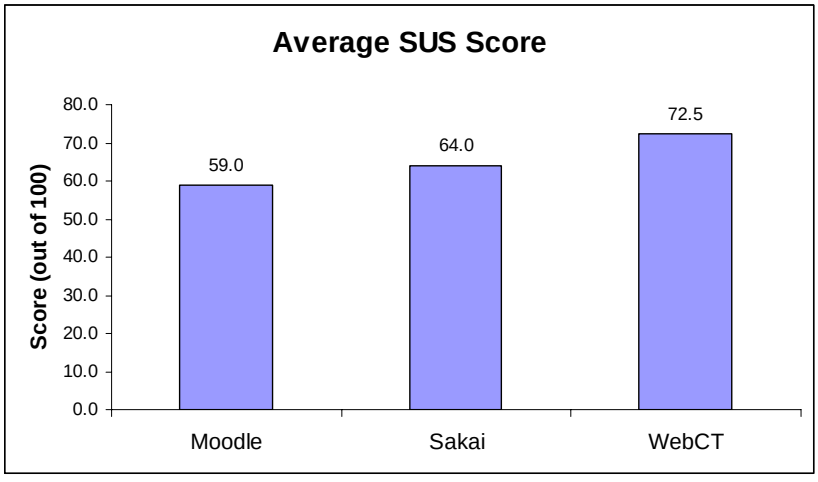

Figure 9: Average SUS Score

SUS Score	CMS		
	Moodle	**Sakai**	**WebCT**
Mean	59.0 ± 21.5	64.0 ± 8.4	72.5 ± 8.9
Range	(20.0, 90.0)	(42.5, 72.5)	(52.5, 82.5)
1st Quartile	38.75	61.25	67.5
3rd Quartile	73.75	68.75	80
IQR	35	10	12.5

Table 4: SUS Scores

Based on the data, it appears that users either really liked Moodle or hated it. WebCT and Sakai users were more consistent in their appraisal, with WebCT being ranked the higher of the two.

Qualitative

The main issues users encountered across all systems fell into two main areas: navigation and non-standard user interfaces. Navigation errors were either issues with naming or with layout on the web page. There was at least one major naming issue with each CMS. WebCT referred to quizzes as assessments; Sakai referred to calendars as schedules; and Moodle referred to discussion boards as forums. WebCT also lists the course's main page as a link titled "Course Content"; however, the link is supplemented by a house icon which did indicate to a number of users that it was for the home page. The breadcrumb trail excluded the homepage depending on where the user was in the course. Other users tried clicking the "My WebCT" link but that brought them to the CMS home page, which is the first page they see after logging in where the user selects a course. In each case, users were confused by the terminology used in the directions not matching with the links (or icons) as shown on the web page. It was interesting to note that users followed 1 or more of the following strategies when trying to find information:

- Random clicking on links, regardless of the link;
- Viewing the calendar to find content;
- Searching the course using the CMS search tool.

Random clicking was the primary and most frequently used strategy of all users. None of the users attempted to view the help files for the system on any of the CMS. This may be an indication of general computer usage patterns for the age group, where they are more likely to Google software problems rather than consult what can be hard-to-use documentation and help files. The search feature was used only once, by a Sakai participant.

As for the placement of links on the page, users were confused as to having the course links across the top of Sakai's home page, where they needed to select a course to view any content. Instead, users assumed they were immediately in the class after logging in. In contrast, WebCT and Moodle clearly list the courses in the middle of the page, as the main focus of the users activity – getting to a specific course. The other navigation

layout issue was in Moodle and stemmed from having the calendar on the right side of the screen. However, this might be an element the course instructor can move around on the page.

Conclusion

While technology-based learning has been around since before the internet, there is still a large degree of improvement that could be made to the currently available course management systems. First, software developers should keep in mind one of their primary audiences, students, and use vocabulary and terminology that is appropriate for them. For example, "assessment" is a term commonly used by instructors, but not by students. Secondly, while a CMS is more complex than some web pages, it is still a web-based system and as such should try to follow generally accepted rules of behavior for web pages. One example would be that the Back button breaks in most cases, rendering it useless to users. Third, course developers, instructors, or the institutions academic technology department should provide some sort of guide to using the course management system. Most helpful would be screen casts that demonstrate various features students can expect to use in their courses. And, lastly, instructors should strive to provide as many cross-links and ways to find tools and content in a consistent manner as possible in their course.

Although this study took a narrow approach to studying CMS usability, it's results immediately suggest that some changes be made to each course management system. In the future, it will help inform other phases of this usability study and be used to generate heuristics for course management system usability.

References

Barnum, C. M. (2002) *Usability testing and research*. New York: Longman.

Brooke, J. (1996). SUS: A quick and dirty usability scale. In: P.W. Jordan, B. Thomas, B.A. Weerdmeester & I.L. McClelland (Eds.), *Usability Evaluation in Industry*. London: Taylor & Francis.

Green, K. C. (2006) *Campus Computing 2005: The 16th National Survey of Computing and Information Technology in Higher Education.* Encino, Ca: Campus Computing.

Hawkins, B. L., Rudy, J. A., Nicolich, R. (2005) *Educause Core Data Service Fiscal Year 2004 Summary Report*. Boulder, Co: Educause.

Nielsen, J. (1993) *Usability Engineering*. San Francisco: Morgan Kauffmann.

Nielsen, J. (2000) *Usability testing with 5 users*. Retrieved on April 5, 2007 from http://www.useit.com/alertbox/20000319.html

Tullis, T. S., Stetson, J. N. (2004) A comparison of questionnaires for assessing website usability. Proceedings of the Usability Professionals Association 2004 Conference, Minneapolis, MN, June 7 – 11, 2004.

U. S. Department of Health & Human Services. (n.d.) *Videotape consent form.* Retrieved July 3, 2006 from http://www.usability.gov/templates/docs/release.doc

Usability.gov. (n.d.) *Usability methods*. Retrieved April 5, 2007 from http://www.usability.gov/methods/