

GAP ANALYSIS OF EDUCATIONAL WEB TOOLS IN ENGINEERING AND TECHNOLOGY

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ABSTRACT

A gap analysis of Web tools in Engineering was undertaken as one part of a larger grant entitled Digital Library Network for Engineering and Technology (DLNET) (funded by NSF DUE-00-85849). The DLNET project seeks to build a Web portal and an online review process to archive quality knowledge objects in Engineering and Technology disciplines. The gap analysis purposefully preceded the development of this portal to identify Web tools used or desired by faculty and students to help process Engineering and Technology information in the portal.

THEORETICAL FRAMEWORK

The emergence of Web portals to educational content has helped transform traditional links between knowledge developers and users. Where knowledge developers once were required to publish and market their content through publishers, libraries, and bookstores, they may now submit knowledge objects directly to public portals for immediate access and use by peers. One primary gain from Web portals is efficiency of dissemination. Faculty and students can access more information more quickly than before. These gains are positive, but they are not complete. Often, the educational method remains top-down delivery of content to the user (Oliver, 2001). Student processing of information is not necessarily changed, unless a knowledge object happens to be a high-quality interaction or simulation. To fully complement Web portals, it is critical to

integrate or recommend educational Web tools that provide the means for students and faculty to process and effectively utilize the growing body of content.

Popular course management systems such as Blackboard (2001) and WebCT (2001) have found their way onto college campuses. They provide mechanisms for delivery of content, quizzing, and some group communication and file sharing. Additional information processing tools have been developed by educational researchers, however, that are not rapidly disseminated to the general education community by such commercial products. These tools include such features as establishing group project plans via templates (Hung & Wong, 2000), collecting and generating diagrammatic displays of Web searches (Beckman Institute for Advanced Science and Technology, 2001), archiving group-gathered data via Web forms (Means & Coleman, 2000), organizing Web information or links into problem-related or conceptual categories (Slotta & Linn, 2000), integrating or annotating one's notes or thoughts with different Web resources (Berkman Center for Internet & Society, 2000; McHenry, 2000; Weborganic Systems, 2001), and collaboratively editing a Web document (Guzdial, in press) or concept map (Institute for Human and Machine Cognition, 2001). A key goal of this analysis was to extricate and prioritize these types of tools desired by instructors and students in Engineering and Technology disciplines, to raise awareness of gaps between existing and needed Web tools.

PROCEDURE

The gap analysis was divided into three activities. During the Fall of 2000, we identified a panel of Engineering and Technology faculty using Web tools by inviting participation from faculty teaching continuing education courses online with grant partners at the Institute for Electrical and Electronic Engineers (IEEE) and the American Society for Engineering Education (ASEE). We extended the invitation to all faculty in the eight Engineering schools of NSF's

SUCCEED Engineering Education Coalition. To generate a more national sample, we also sent e-mail invitations to all Engineering faculty at six additional institutions located in the Midwest, West, and Southwest.

From November 2000 through early January 2001, we collected panelists' registration information and initial recommendations for Web tools via Web forms (Educational Technologies, 2001). Faculty were asked to submit recommendations for existing and hypothetical Web tools that would support both their teaching and their students' learning. We appended other non-represented features to the panelist's recommendations. These additions were based on three factors: 1) existing tool taxonomies (Future University, 1999; Hannafin, Land, & Oliver, 1999; IEEE Learning Technology Standards Committee, 2000; Landon 2000; Wicks 2000), 2) ongoing discussions with the IMS Global Learning Consortium regarding the standardization of feature specifications in learning management systems (McHenry, 2000), and 3) new tool features and characteristics found in a review conducted of Web course management systems.

Between February and May 2001, the appended master feature list was submitted to the Delphi panelists for a second survey round. Panelists were asked to reflect on and use a Likert scale to agree or disagree with the usefulness of the various features. An online form expedited this ranking. By converting Likert rankings to numeric form, rank-ordered feature lists were derived, describing highest rated tools overall, as well as highest rated tools in specific thematic tool categories (e.g., tools to disseminate or retrieve Web content, tools to process Web content, tools to collaborate or work with others, etc.). One list for all Engineering and Technology faculty was generated, as were several discipline specific lists (e.g., Civil Engineers).

DATA SOURCES

The primary data sources to generate feature lists were participating faculty and educational literature describing Web tool research. The marketing efforts assembled a panel of 66 faculty from over 40 different institutions in the United States and Canada. Each of the 66 panelists submitted their first round recommendations for Web tools, with 56 or 85% of panelists completing their participation by ranking the recommended tools in round two of the gap analysis.

ROUND ONE ANALYSIS AND RESULTS

To sort the round one recommendations, the following question was asked of each submission: "Who does the tool benefit most?" Three categories emerged during our compilation of the panelists' submissions: tools that benefit the instructor, tools that benefit the student, and tools that benefit both equally. If a tool benefited "both," we asked a second question: "Is there a situation when the instructor and students would use this tool for different purposes?" If the answer to this question was "Yes," then the tool was sorted twice under "instructor" and "student" categories, because the instructor might rate such tools highly to serve their purposes, but low to serve student purposes, or vice versa.

To help describe the recommendations, we found it useful to ask, "What makes the item described a 'Web' tool?" For instance, some faculty recommended Photoshop to generate images. This software is not a Web tool, but the software or system that allows an instructor to post images online and students to access this information is a Web tool. In such cases, we interpreted the panelists' intent as the latter Web component.

ROUND TWO ANALYSIS AND RESULTS

The 51 recommended tools from round one of the gap analysis were rated by each panelist in round two. Each panelist was listed along the left-hand column of an Excel spreadsheet with

their Likert scale ratings for the recommended tools listed across the row with their name. The Likert scale ratings were converted to a mathematical scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree. Average ratings were computed for each recommended tool across all panelists, and a comprehensive rank-ordered list was created by value.

Faculty expressed a need for most of the recommended tools in the study by ranking 13 tools with an average value between four and five on the Likert scale (agree to strongly agree that I need the tool), and by ranking 37 of 51 tools with an average value between three and four on the Likert scale (neutral to agree that I need the tool). Only one tool was ranked below a neutral value.

Four engineering discipline areas contained enough panelists to warrant the creation of separate rank-ordered lists: civil and environmental (11 panelists), chemical (9 panelists), electrical and computer (10 panelists), and industrial and systems (7 panelists). For the purpose of statistical analysis, a fifth group was created consisting of "other" panelists not included in the four largest sub-groups.

Statistical comparisons were sought to determine if differences existed between how groups rated individual tools as well as how groups rated tools in the ten thematic categories (e.g., content development tools, information dissemination tools, assessment tools, etc.).

Each panelist was sorted into one of the above five groups. An average score, over the tools of each category, was computed for each person. A two-way analysis of variance for repeated measures was ran using SAS software with the ten thematic categories as the repeated measures dependent variable and group as the independent variable. This analysis indicated no significant differences between group averages across the ten categories. This finding indicates for a given

category such as communication tools, the average group ratings were similar. A significant difference at the $p < .0001$ level was noted, however, among the ten thematic categories within the groups. This finding indicates within a given group such as civil engineering, the average category ratings were different. A group would place different importance on the tool categories. No interaction effect was noted between groups and the tool categories.

Ten one-way anovas were also ran to determine if the five groups differed on their average ratings of the ten thematic tool categories. As suggested by the one-way anova, no significant differences were found. For each of ten tool categories, the five groups reported similar ratings. Finally, 51 one-way anovas were ran to determine if the five groups differed on their average ratings of any of the 51 recommended tools. Only three tools were found to contain significantly different group ratings at the $p < .05$ level. Out of 51 analyses, however, these three differences could be attributed to chance or error, and thus are not singled out here.

Since differences were noted among the ten thematic tool categories within the groups, table one was generated to illustrate the average rank-order and the average Likert ratings for each tool category. While the category differences are small, it is worth noting their relative order. The most desired Web tool type is faculty tools to create Web content. This tool type is associated with a top-down, didactic approach to teaching. In fact, the top four ranked and rated tool categories are all associated with an instructivist approach to teaching--development of content, delivery of information to learners, and follow-up assessment. It should also be noted that three of the four lowest ranked and rated tool categories are all associated with a more democratic or constructivist teaching style--providing students with activities, interactions, and collaborative opportunities. This analysis provides evidence that the Engineering and Technology panel

surveyed places more importance on tools that support traditional teaching practices over tools that would enable different student-centered techniques.

Table 1. Thematic Tool Categories: Most Desired to Least Desired

Tool Categories	Category Codes	Average Category...	
		Rank Order	Likert Rating
Faculty Tools to Create Web Content	CF	10.6	4.138
Assessment Tools for Faculty/Students	AB	18.7	3.911
Faculty/Student Tools to Disseminate or Retrieve Web Content	DB	20.1	3.902
Assessment Tools for Faculty	AF	25.8	3.774
Student Tools to Collaborate or Work w/ Others	WS	28.5	3.712
Course Management Tools for Faculty/Students	MB	30.3	3.688
Student Tools to Process Web Content	PS	31.2	3.650
Faculty/Student Tools to Collaborate or Work w/ Others	WB	31.8	3.576
Faculty Tools to Collaborate or Work w/ Others	WF	37.5	3.573
Student Tools to Create Web Content	CS	42.5	3.293

Table two provides a description of each tool rated by faculty, and presents the tools from highest to lowest ranked overall. The "value" column represents the average Likert rating across the panel from five (strongly agree that I need the tool) to one (strongly disagree that I need the tool). The "code" column indicates to which tool category a specific tool belongs along with a unique number for each tool in that category.

Table 2. Specific Tool Rankings: Most Desired to Least Desired

Rank	Value	Code	Description
1	4.661	CF-1	I need a content development tool to create Web-ready documents containing predominantly text and images. Sample software tools in this category include: Adobe Acrobat for creating PDF files; Frontpage, Dreamweaver, Netscape Composer, Word, or an HTML editor for creating standard Web files.

2	4.375	DB-3	I need an information dissemination tool to post my homework assignments, lab assignments, problems, or exercises online, and my students to access, print, or download this information to complete outside of class time. Answers and solutions to the assignments may also be posted online. This category includes such tools as Labview and Mathcad through which the instructor constructs exercises for students to download and run on their computers.
3	4.370	DB-1	I need an information dissemination tool to post my course schedule, calendar, and/or syllabus online. My students will be able to quickly access this information on campus or in their homes.
4	4.304	DB-2	I need an information dissemination tool to post my lecture notes, examples, whiteboard images from class sessions, or Powerpoint slides, online. My students will be able to quickly access this information if they missed class or desire lecture materials for self-study.
4	4.304	CF-2	I need a content development tool to create Web-ready documents with mathematical equations; to write equations and math symbols as fast as writing regular text. Sample tools in this category include LaTeX and MathEQ.
6	4.214	CF-6	I need a content development tool to create Web-readable, static or animated graphics, or 3-dimensional objects. Sample software tools in this category include: Photoshop, Visual Basic for online modeling; Jwave or LiveMath for turning data into 3-D surface images, X-Y plots, polar plots, animations, contours, etc.; Flash, Video Studio, or Ray Dream Studio for creating animated sequences; or virtual reality markup language (VRML).
7	4.164	CF-3	I need a content development tool to scan print-based documents, and save these in Web-readable formats (e.g., HTML, PDF).
8	4.143	DB-4	I need an information dissemination tool to post my learning objectives for exams and quizzes, old print-based exams, and/or solutions to the questions online. My students can access, print, or download this information to practice for upcoming exams.
9	4.130	WB-1	My students and I need an online communication tool to converse in an asynchronous format. Specific tools might include e-mail, listservs, newsgroups, or threaded discussion boards.
10	4.091	AB-3	My students and I need an online gradebook to store their grades. Students should be able to access their individual scores in a secure location. The gradebook should be flexible to allow not only numeric scores, but also statements regarding lab performance, demonstration performance, and general comments about student progress. The gradebook should integrate with the university grade reporting system.
11	4.073	CF-4	I need a content development tool to capture computer screen images and place them on the Web.

12	4.054	AF-1	I need a student tracking tool to determine which Web pages the students have viewed on my Web site, when, and how often. The data might be used for assessment purposes (e.g., giving credit for completing online exercises) or to determine the content students find most useful. Tracking could be extended to course assignments, allowing the instructor to monitor students' progress as they worked through a series of tasks.
13	4.000	CF-7	I need a content development tool to create Web-ready tutorials or demonstrations of processes for students to read, view, or self-study (e.g., demos of concepts like radioactive decay chains). Sample software tools in this category include: Toolbook Instructor, Director, and Authorware.
14	3.982	PS-5	My students need manipulation or simulation tools to interact with models, events, or calculations that I've created (e.g., java applets that allow students to modify variables in water quality models, rainfall-runoff models, heat transfer models, or other phenomena to better explore relationships and visualize results; LiveMath or MatLab modules placed online that allow students to change mathematical input expressions and observe resulting changes on graphs and 3-D images).
15	3.946	CF-8	I need a content development tool to create audio and/or video content for Web delivery. Various software tools in this category include: Real Presenter, Real Producer, and Netshow, to capture audio and video from classroom lectures for streaming, and to coordinate or synchronize these files with associated slides or drawings that were displayed during the lecture (e.g., narrated slides).
16	3.929	AF-3	I need an online gradebook that interfaces with student tracking data, to correlate quiz/test performance with student access to online materials, tutorials, exercises, etc. (i.e., Did students who score poorly on a test access fewer online resources than students who scored well?).
17	3.927	DB-5	I need an information dissemination tool or database to post course content online in various formats for students to view, download, or stream to their desktops. This might include text, image, graphic, animation, audio, or video files, in addition to external Web links or tutorials. In some cases, students might need a plug-in to view the files (e.g., Real Player).
18	3.911	MB-2	My students and I need an online course hosting tool to manage many or most of the course functions listed in the survey: information dissemination, quizzing, communication, file exchange. Sample tools in this category include: WebCT, Blackboard, Virtual University, and eCollege.

19	3.891	PS-8	My students need an interactive, problem-solving tool to formulate and solve problems online, showing various steps and calculations as if done by hand on paper. The problem components should be interrelated like a spreadsheet, so when one part of the solution is changed, other dependent parts also change accordingly.
20	3.873	DB-10	I need archival tools to save student questions for the purpose of generating a frequently asked questions (FAQ) database for my course. Students might be provided with a discussion board or listserv to post their questions. After finding questions that students ask repeatedly or issues that cause difficulty, I can move those items to a FAQ database with a standard response or study advice for all to view.
21	3.857	PS-1	My students need seeking tools to search for online information (e.g., search engines); advanced filtering or "recommender systems" that retrieve and sort relevant online literature and industry news according to criteria defined by the students; a customizable search engine to meet the discipline-specific research needs of individuals or collaborative teams.
22	3.839	AB-1	My students and I need a student-to-instructor file exchange tool for students to upload their assignments, reports, or projects. The tool would time-stamp uploaded documents. This tool might represent the student's "portfolio" space where several course-related files are stored.
23	3.836	DB-7	I need a virtual library with full journal article access, allowing my students and I to search content in specific course areas (e.g., thermodynamics, heat transfer, etc.).
24	3.804	AB-2	My students and I need an online quizzing and testing tool to assess their progress in the course. The system should be capable of displaying symbols or equations in both questions and answers. If an instructor deems necessary, the system should allow for questions of increasing difficulty if students continue to perform well, and allow the student to retake an item for less credit if they missed it the first time.
25	3.782	PS-2	My students need collecting tools to store online information that they find during research (e.g., collecting facts, text, pictures, video clips, or links that are related to some concept or topic). Bookmarking tools and individual file space are types of collecting tools.
26	3.750	WS-1	My students need student-to-student file exchanging tools to share documents and to view others' reports and designs. Such tools might resemble a public drop box for the entire class or private drop boxes for project teams. The drop boxes should date and time-stamp posted documents to help students track version changes.

26	3.750	AF-4	I need an online survey tool that allows my students to post opinions and feedback regarding the course (e.g., most and least important items learned from a given lecture, instructor performance, TA performance, etc.).
28	3.741	CF-5	I need a content development tool to write on a whiteboard or smartboard, then immediately post these course examples, notes, or exercises on the Web; reduces the amount of time needed to prepare materials.
29	3.709	WB-5	My students and I need integrating tools that are part of my communication tools, particularly asynchronous communication tools like discussion boards, so that we can attach drawings, sketches, schematics, programming code, or audio/voice clips, to the otherwise text-based, course discussions. Such tools are useful for elaborating on course discussions or for students to share their work with the instructor or peers for the purpose of receiving feedback or help on their questions.
30	3.691	PS-9	My students need data processing and visualization tools to process raw scientific data, visually interpret results, create models, etc. Sample tools in this category include: JWave for distributed processing of large scientific data sets from multiple computers, or MatLab.
31	3.673	WF-2	I need an instructor-to-instructor file exchange tool to share files with other instructors teaching similar courses. The tool could facilitate the development of a shared library, database, or archive of instructional modules that could be purchased or reused to create new courses, rather than re-inventing these items for each new course. Modules placed in the shared database could be tagged with keywords or topics, so an instructor teaching a specific topic could download relevant materials to auto-generate their new course.
32	3.643	WB-4	My students and I need advanced editing and critiquing tools for course file exchange boxes to electronically mark-up documents (e.g., reports, Web pages). Sample features might include the ability to red-line text segments, attach electronic sticky notes, or use an electronic pen and pad to circle mistakes and hand-write comments in the margins. The tool would support both instructor grading of student documents and peer critiquing of one another's work.
33	3.611	DB-8	I need archival tools to clip or save portions of asynchronous communications (e.g., e-mails, discussion board transcripts) for the purpose of saving and sharing particularly good discussions with future students.
34	3.600	CS-1	My students need content development or information generating tools to create Web-ready documents containing predominantly text and images.

35	3.589	CS-2	My students need a content development or information generating tool to create Web-ready documents with mathematical equations; to write equations and math symbols as part of homework assignments. Sample programs in this category include: MathEQ.
35	3.589	MB-3	My students and I need an enterprise system which encompasses and integrates several online courses. Instructors and students log-into the system and can access all of their courses from one main portal (i.e., user-oriented, not course-oriented). Student advisors can track student performance across a program of study, rather than one course alone.
37	3.574	AF-5	I need a data collection tool to post forms online and capture information from my students in a database. Sample tools in this category include: Cold Fusion Markup Language (CFML) to connect databases to the Web.
38	3.564	AF-2	I need a filtering tool to check student work for plagiarism.
38	3.564	MB-1	My students and I need a pacing tool to scaffold or restrict their access to information on my Web site (e.g., students can't view chapter 3 until they've taken the chapter 2 quiz). Students will not be able to see certain portions of the Web site until a set rule has been met (e.g., a certain date, a passing mark on a test), or students are led to different sections of a Web site based on their response to prerequisite-type questions (i.e., if students lack prerequisite knowledge, they can be led to content serving as remediation).
40	3.554	PS-7	My students need manipulation or simulation tools that provide them with virtual laboratory experiences (e.g., troubleshooting electronic circuit components, practicing on virtual SEM or TEM lab apparatus, etc.).
41	3.518	PS-3	My students need organizing tools to sort and arrange the online information that has been collected or exchanged (e.g., online concept mapping or diagramming tools that can be edited by a group over the Web).
42	3.500	PS-4	My students need integrating tools to merge their ideas and thoughts with online content (e.g., web annotation software for students to post notes or questions directly on a Web site, or to mark-up or leave critiques directly on a Web site; ability to attach a sketch or graphic image to a portion of a Web site for the purpose of elaborating on the original document).
43	3.491	WS-2	My students need a comprehensive project management system containing most or all of the features mentioned in this survey for groups or teams to collect and exchange information, organize information, generate information, communicate, and plan project processes like issues tracking, approval routing, or change order coordination (e.g., real life project management on construction projects).
44	3.473	WF-1	I need a student grouping tool to create student teams.

45	3.315	DB-9	I need archival tools to record synchronous communications (i.e., live chat and live audio/video sessions) for students to replay and review whenever they miss a session or whenever they desire a slower playback for better processing of the content. "Persistent" chat would allow a student to access all the previous messages that were typed in the order they were typed.
46	3.268	DB-6	I need an information dissemination tool that allows my students and I to demonstrate applications or events synchronously or in real-time over the Web (e.g., screen sharing features to demonstrate an application or to train others in the use of an application; live Web cams to broadcast laboratory experiments, outdoor construction activity, field trips).
47	3.214	WB-2	My students and I need an online communication tool to conduct text-based communication in a synchronous format. Specific tools might include live chats or AOL's instant messenger.
48	3.182	WB-3	My students and I need an online communication tool to conduct audio or video-based communication in a synchronous, real-time format (i.e., I can hear and/or see the students online in real-time; they can discuss projects with their teams; they can present oral briefings to the class; they can ask questions or post questions in a text window; they can view and collaboratively edit a whiteboard). Tools in this category include: Mentergy, Windows NetMeeting, Symposium, and ClassWise.
49	3.073	PS-6	My students need manipulation or simulation tools to explore spatial relationships (e.g., modifying shapes to create products for which assembly instructions could be written).
50	3.036	CS-3	My students need content development or information generating tools to create Web-readable, static or animated graphics, or 3-dimensional objects.
51	2.945	CS-4	My students need content development or information generating tools to create audio and/or video content for Web delivery.

EDUCATIONAL IMPORTANCE

The project benefits will extend beyond this initial analysis. We have already integrated the final feature lists with Web annotation software, so that faculty who view the lists may attach comments describing how they are applying or would like to apply the recommended tools in their courses. These comments will allow us to build a valuable database of not only recommended features, but also teaching strategies for specific tools. Further, links will be made between the recommended features and existing tools that support those intentions where

available. Such linkages will be useful to pinpoint desired features for which no tools currently exist. These gaps can then be utilized by courseware developers and industry to address areas of need with future product releases. Finally, links will be made between the recommended features and specific knowledge objects deposited into the DLNET portal to illustrate further applications for the tools.

REFERENCES

- Beckman Institute for Advanced Science and Technology. (2001). VisIT: Visualization of information tool. [On-line]. Available: <http://visit1.vp.uiuc.edu/index.html>
- Berkman Center for Internet & Society. (2000). Annotation engine. [On-line]. Available: <http://cyber.law.harvard.edu/projects/annotate.html>
- Blackboard, Inc. (2001). *CourseInfo*. [On-line]. Available: <http://www.blackboard.com/>
- Educational Technologies. (2001). Gap analysis of Web tools in Engineering. [On-line]. Available: <http://www.edtech.vt.edu/dlnet/>
- Future University. (1999). Comparative features analysis of leading course management software. [On-line]. Available: http://www.futureu.com/cmscomp/cms_comp.html
- Guzdial, M. (in press). Collaborative Websites to support an open authoring community on the Web. *Journal of the Learning Sciences*. [On-line]. Available: <http://guzdial.cc.gatech.edu/papers/CoWeb/>
- Hannafin, M. J., Land, S., & Oliver, K. (1999). Open learning environments: Foundations, methods, and models. In C. Reigeluth (Ed.), *Instructional-design theories and models: Volume II* (pp. 115-140). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.
- Hung, D. W. L., & Wong, A. F. L. (2000). Activity theory as a framework for project work in learning environments. *Educational Technology*, 40(2), 33-37.
- IEEE Learning Technologies Standards Committee. (2000, April). [On-line]. Available: <http://www.manta.ieee.org/p1484/>
- Institute for Human and Machine Cognition. (2000). Concept map software: A knowledge construction toolkit. [On-line]. Available: <http://wwwcmap.coginst.uwf.edu/>
- Landon, B. (2000, March). Online educational delivery applications: A web tool for comparative analysis. [On-line]. Available: <http://www.ctt.bc.ca/landonline/sideside.html>

McHenry, B. A. (2000, March). New features for learning management systems. [On-line]. Available: <http://www.imsproject.org/feature/lms/lms.html>

Means, B., & Coleman, E. (2000). Technology supports for student participation in science investigations. In M. J. Jacobson, & R. B. Kozma (Eds.), *Innovations in science and mathematics education: Advanced designs for technologies of learning* (pp. 287-319). Mahwah, NJ: Lawrence Erlbaum Associates.

Oliver, K. M. (2001). Recommendations for student tools in online course management systems. *Journal of Computing in Higher Education*, 13(1), 47-70.

Slotta, J. D. , & Linn, M. C. (2000). The Knowledge Integration Environment: Helping students use the Internet effectively. In M. J. Jacobson, & R. J. Kozma (Eds.), *Innovations in science and mathematics education: Advanced designs for technologies of learning* (pp. 193-226). Mahwah, NJ: Lawrence Erlbaum.

WebCT. (2001). *WebCT*. [On-line]. Available: <http://www.Webct.com/>

Weborganic Systems. (2001). *Weborganic systems*. [On-line]. Available: <http://www.weborganic.com/>

Wicks, D. (2000, March). Comparison of on-line education systems. [On-line]. Available: <http://www.spu.edu/~dwicks/comparison.htm>