## Gap Analysis of Educational Web Tools in Engineering

**Abstract (50 words)**
An online Delphi survey with a panel of 67 Engineering faculty from 48 North American institutions is used to determine existing and needed Web tools for Engineering education. Faculty and courseware developers can use recommended feature lists to identify curricular ideas, representative tools, and relevant portal knowledge objects.

### Statement of the Problem

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. 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.

### Description of Project

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 precedes the development of this portal to identify Web tools used by faculty and students to process Engineering and Technology information.

The gap analysis was divided into four activities. During the Fall of 2000, we identified a panel of Engineering faculty using Web tools by communicating with grant partners at the Institute for Electrical and Electronic Engineers (IEEE) and the American Society for Engineering Education (ASEE). We invited faculty teaching continuing education courses through IEEE and ASEE to participate as panelists in a Web-based Delphi survey and feedback process. We extended the invitation to all faculty in the eight Engineering schools of NSF's SUCCEED Engineering Education Coalition.

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 or processing of content. In addition to the suggested list of features generated in the first survey round, we appended other non-represented features to the panelist's list. 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 development and learning management systems (e.g. *WebCT, Ingenium,* and *Courseinfo*).

During February 2001, the appended list will be submitted to the Delphi panelists for a second survey round. Panelists will be asked to reflect on and use a Likert scale to agree or disagree with the usefulness of the various features. An online form will expedite this ranking. A final feature list will be derived, based on the features that most faculty agree or strongly agree would be useful to support their teaching or their students' learning. One list for all Engineering faculty will be generated, as well as several discipline specific lists (e.g., Civil Engineering, Electrical Engineering, Mechanical Engineering).

The final feature lists will be linked to 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 (e.g., "I use collaborative concept mapping in my Electrical Engineering course to..."). These comments will allow us to build a valuable database of not only recommended features, but also teaching strategies for specific tools in specific disciplines. Further, links will be made between the recommended features and existing tools that support those intentions where available, and between the recommended features and specific knowledge objects deposited into the DLNET portal to address the problem of static content.

**Outcome**

The marketing efforts assembled a panel of 67 faculty from 48 different institutions in the United States and Canada. At this time, each of the 67 panelists has submitted their first round recommendations for Web tools. The subject areas with enough panelists to generate discipline-specific feature lists include: chemical engineering (9 faculty), civil and environmental engineering (11), electrical and computer engineering (14), industrial and systems engineering (7), and mechanical engineering (7).

To sort the round one recommendations, the following question was asked of each submission: "Who does the tool benefit most?" Three categories have 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 benefits "both," we ask 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 is "Yes," then the tool is sorted twice under the "instructor" and "student" categories, because the instructor might rate such tools highly to serve their purposes, but low to serve student purposes, or vise versa.

To help describe the recommendations, we have 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.

We plan to report the compiled feature statements back to the panel during February 2001. A small sampling of compiled feature statements is included below for reference.

Sample Faculty Tools
* I need a content development tool that allows me to create audio and/or video content for Web delivery. Various software tools in this category include: Real Presenter, Real Producer, and Netshow, to generate audio/video files of classroom lectures or presentations for streaming, to generate narrated slides to accompany class notes, etc.

* 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 of instructional materials.

* I need a student tracking tool that allows me 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 or to determine the content students find most useful.

Sample Student Tools
* I need collecting tools for individual students 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.

* I need student-to-student file exchanging tools for students to share documents and to view others' reports and designs. Such tools might resemble a drop box for the entire class or separate drop boxes for project teams.

* I need organizing tools for students 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).

Sample Faculty and Student Tools
* I need an information dissemination tool that allows me to post online my learning objectives for exams and quizzes, old print-based exams, and/or solutions to the questions. My students can access, print, or download this information to aid in practicing for upcoming exams.

* I need an online communication tool to converse with my students in an asynchronous format. Specific tools might include e-mail, listservs, newsgroups, or threaded discussion boards.

* I need advanced editing and critiquing tools for course file exchange boxes that would allow me and my students 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, etc. The tool would support both instructor grading of student documents and peer critiquing of one another's work.

**Relevance to Other Institutions**
The project outcomes are relevant to Engineering instructors and courseware developers. Specifically:

* The final feature lists and appended curricular ideas will be useful to Engineering instructors seeking to model best online teaching practices.

* The final feature lists and links to representative tools will be useful to course instructors who need to identify existing tools for specific purposes. Such linkages will also be useful to pinpoint desired features for which no tools currently exist. These gaps can then be utilized by courseware developers to address areas of need with future product releases.

* The final feature lists and links to pertinent knowledge objects deposited in the DLNET portal will be useful to illustrate appropriate Web-based strategies for students to more actively process online content.

**Suggested Audience**

This presentation is of general interest to faculty and courseware developers interested in studying powerful ties between instructional strategy and Web-based functionality.

**References**

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