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Recommendations for Student Tools in Online Course Management Systems

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ABSTRACT

AT LEAST THREE PURPOSES FOR ONLINE TEACHING can be conceptualized: quick dissemination of course information, Web-enabled supplements, and Web-engaged activity. Simply disseminating course information online is necessary for distance courses and promotes efficiency for face-to-face courses, but arguably does not improve learning for either. Web-enabled supplements, however, take advantage of the multimedia nature of the Web, allowing students to research course-related materials previously unavailable or only available in dispersed locations. To promote higher-order thinking, Web-engaged activities can be designed that capitalize on student information processing tools.

A major concern of online course management systems is that they emphasize faculty dissemination tools over student processing tools, even though the latter are more likely to promote student interaction and engagement (e.g., debating, sharing data, developing common products, synthesizing information, exploring cases). Online course management systems should be evaluated on the basis of their ability to support planned learning goals and teaching strategies. Currently, many high-level goals and strategies are supported only by individual online tools. Faculty who rely upon integrated course management systems may be unable to involve their students in such activities as community building, research into ill-defined problems, and knowledge construction. If faculty find online course management systems only support information delivery and low-level knowledge comprehension goals, they should seek alternative tools and development options to engender high-level student analysis, synthesis, and evaluation activity. (*Keywords: Internet, cognitive tools, Web-based instruction, instructional design, constructivism*)

INTRODUCTION

THE PURPOSE OF THIS ARTICLE is to propose a three-tiered model of online teaching, consisting of low-level information dissemination, Web-enabled course supplements, and Web-engaged activities. By comparing existing online course management systems to this model, it is evident that these popular tool systems support low-level information dissemination and Web-enabled course supplements, but they do not necessarily support the full range of Web-engaged activity that is currently possible. Several stand-alone tools that support Web-engaged activity are highlighted in this article to both illustrate specific limitations in online course management systems as well as suggest improvements to these comprehensive tool systems. Further, this article recommends several effective teaching strategies enabled by Web tools that may be applied to both on-campus and distance courses.

What are online course management systems, and what are the advantages to using them? Online course management systems are software packages that reside on an Internet server and provide various functions such as storing course-related information online and electronically quizzing students (see, for example, Blackboard Inc., 2001; WebCT, 2001). Faculty who teach face-to-face courses on traditional campuses as well as faculty who teach courses at a distance use online course management systems. The systems are popular with faculty members who are unfamiliar with Web development or with managing files on a Web server, because they provide easy-to-use templates or empty electronic folders into which faculty up-

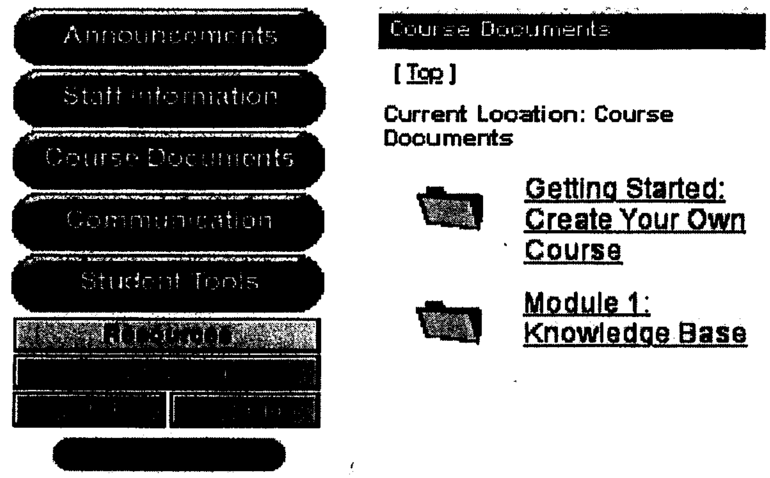


Figure 1. Blackboard Inc. (2001) CourseInfo interface with content folders

load basic course information and syllabi or course handouts and documents. Figure 1 illustrates the online CourseInfo interface with some of the standard buttons or suggested course components—staff information, course information, course documents (Blackboard, Inc., 2001). Perhaps, the advantages in using a course management system are the added features that may not be present in a self-built Web site without considerable programming effort. For instance, faculty can conduct online quizzes that are automatically-scored by the system. Electronic gradebooks can be maintained, permitting students to easily monitor their course progress. Further, students can also access discussion boards, chat rooms, and electronic group work areas.

Although online course management systems provide students with some tools to process information, they rarely provide a full-range of interactive options available. Currently, emphasis remains on development tools for faculty to deliver content to learners. While course management systems may help faculty efficiently disseminate information, simply delivering information online does not take advantage of the Internet's capabilities for active learning. Tool suites that focus on content delivery are more suitable for distance educators who have no other recourse for delivering content. Faculty members who are able to deliver content face-to-face may find less use for these tools if they add no real value to the classroom (e.g., interactivity). The choice to invest in an online course system should be based on a careful analysis of what faculty wish to accomplish online, and the extent to which a system supports those teaching and learning goals.

INSTRUCTIONAL DESIGN FOR ONLINE TEACHING

TO FACILITATE PLANNING FOR ONLINE TEACHING, faculty should create a four-column table or list (see Table 1). Goals for a course or the topics one teaches should be listed in column one. Strategies one wishes to employ to help students meet those goals should be listed in column two. Special emphasis should be placed on the Internet's capabilities when choosing strategies. Students are able to engage in many unique activities online, including: mentoring, debating, role playing, sharing data, developing common products, traveling virtually, synthesizing information, exploring cases and problems, and accessing tutorials or simulated environments (Oliver, 2000). Each of those strategies may be considered "active," and each is more likely to lead to "higher-order" learning outcomes than if students simply read an online handout or Web page and take a quiz. Higher-order outcomes refer to student proficiency at applying, analyzing, synthesizing, or evaluating information (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956). They are distinguished from lower-order skills such as knowing or restating a concept.

In column three of your table, list all of the materials needed to support your strategy or activity. These materials comprise the Web elements you will need to develop (e.g., scaffolding, and worksheets). In column four of your table, list the tools that your students will need to engage in activities. Before selecting an online course management system, take a moment to compare its features against the

Table 1.
Planning Template for Online Teaching

Goals	Strategies	Materials	Tools

features your activities require. Choose only those tools that can help you accomplish your teaching goals. In many cases, the tools required may not be part of existing course management suites. Rather than compromising instructional strategies and activities beneficial to learning, faculty may need to look beyond available online course management systems to the many tools that are being developed by educators (see Merlot, 2001) and educational researchers (see Guzdial, in press; University of Michigan, 2000; Slotta & Linn, 2000) or consider grant support for developing new tools that address instructional needs.

PURPOSES FOR ONLINE TEACHING

AT LEAST THREE DIFFERENT PURPOSES for online teaching can be conceptualized: quick dissemination, Web-enabled supplements, and Web-engaged activity. "Quick-n-dirty" dissemination arguably adds no real value to existing face-to-face courses, except providing student access to course materials more efficiently. The focus is simply disseminating information to anyone at anytime. Web-enabled supplements are more justifiable, because students are provided with access to resources they would not otherwise have an opportunity to view or study (e.g., audio, video, multimedia libraries, and digital libraries). Web-engaged activity typically requires the creation of support structures and tools to support student engagement with course content and processes.

QUICK DISSEMINATION

Word processing and presentation software can be considered rapid Web development tools. Faculty can quickly save their text documents or electronic presentation files in the hypertext markup language (HTML) format. HTML files are then placed on a Web server or uploaded to an online course management system. This type of online content delivery is advocated so that students who miss a class can access the same course documents, lecture notes, assignment sheets, worksheets, or the syllabus that was distributed in class. This type of online dissemination is criticized for allowing students to miss class and for not taking advantage of the Internet's capabilities for interaction and student engagement.

WEB-ENABLED SUPPLEMENTS

Faculty can create new materials that take advantage of the Internet's multimedia capabilities. Some multimedia benefits include the ability to develop tutorials and simulations (see Merlot, 2001), realistic cases and problems (see Figure 2; Society for Pediatric Pathology Online, 2000) as well as the ability to support student research with extensive slide archives, oral histories, or digital libraries (see Figure 3; Ayers & Thomas, 1998). Figure 3 illustrates the Valley of the Shadow Project developed at the University of Virginia. With this extensive collection of newspaper documents, images, and firsthand accounts, faculty can develop assignments that allow students to conduct research in areas of interest (e.g., "Students will examine nineteenth-century newspapers, census manuscripts, and a last will and testament to explore aspects of the Irish and German immigrant communities in the 1850s and 1860s. Students will read newspaper articles about trains and railroads to examine the effect that this new mode of transportation had on life in two late antebellum counties" Ayers & Thomas, 1998).

In his manuscript, Ayers (1999) reflects on Robert Darnton's conceptions of electronic documents. The future of electronic media is not simply one-layered, delivering content to the learner. Rather,

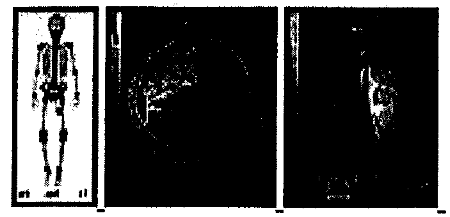
Pediatric Pathology Case Studies

Case 04 -- Pain in Left Proximal Medial Thigh

PATIENT HISTORY:

The patient was a 9 1/2 year old boy with pain in his left proximal medial

RADIOLOGY (MRI)



Nuclear medicine whole body image demostrates a mass in the left medial

GROSS DESCRIPTION

MICROSCOPIC DESCRIPTION

FINAL DIAGNOSIS

Figure 2. Pediatric Pathology case studies

multiple layers will be designed to benefit students, including different perspectives on the original document, historical or chronological perspectives, pedagogical advice for using the document in teaching and learning, and finally, an interactive layer whereby students, teachers, and professionals can discuss and question the work. Too often, this last interactive layer is missing from online teaching. Faculty should not only deliver materials online (layer one), but also consider additional layers that promote activity with online content. Tools to support online activity are now considered.

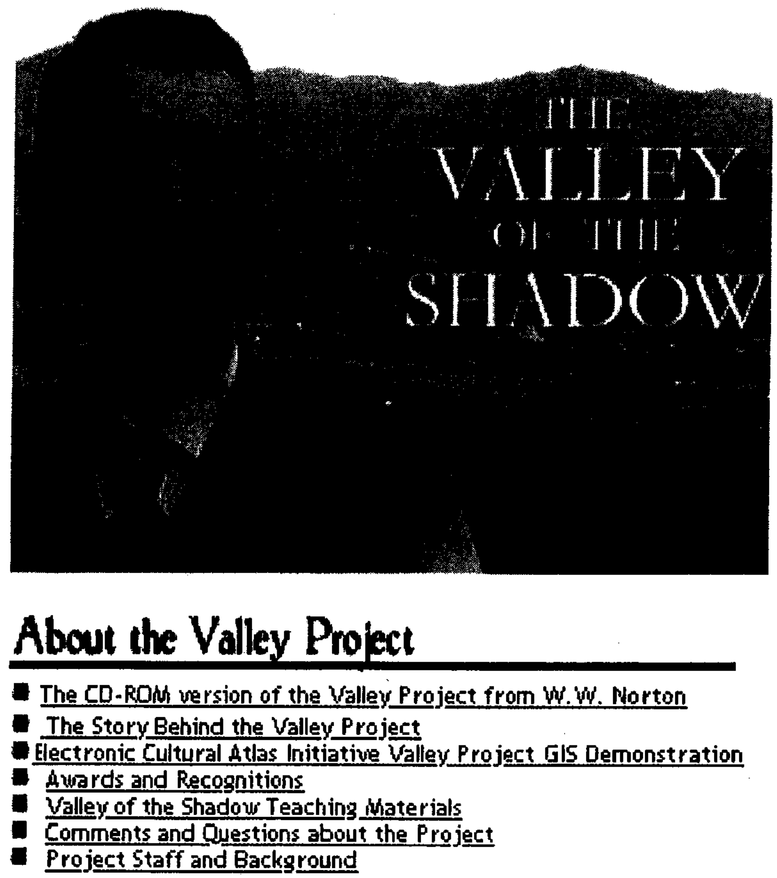


Figure 3. Valley of the Shadow digital library

WEB-ENGAGED ACTIVITIES

Web-engaged activities involve students in processing online information with tools. Table 2 outlines various student processes that can be supported with online tools (Hannafin, Land, & Oliver, 1999). Faculty should decide upon strategies for student engagement, then select those online course management systems and tools that support

Table 2.
Matching Online Teaching Srategies with Available Internet Tools

If you want your students to engage in these processes...	**Consider the support of these Internet tools...**
seeking or researching real-world examples of issues addressed during class meeting periods	e-mail to communicate with professionals in a given discipline, or with recent graduates working in the field, discussion boards for posting and providing commentary on pertinent Web sites and news issues, note takers to annotate pertinent resources
collecting resources to inform a project or problem	bookmarking mechanisms, electronic file box to store images or media files
developing mental models of relationships in a process, system, or theory	concept mappers to diagram and annotate relationships between Web resources
making connections across perspectives	Web page editors for students to create individual Web pages and make links to classmates' pages to point out commonalties and conflictions
managing a project, problem, or process	process scaffolds for students to set goals, timetables, and plan for activities to be completed
testing assumptions, predictions, or hypotheses about subject matter (e.g., "if I do this, I predict this will happen...")	simulations, interactions, and experimentation with subject matter for students to model and revise assumptions
working cooperatively on projects	electronic file sharing for students to edit and revise group documents, discussion boards for students to dialog on issues, Web-accessible white boards where students can cooperate visually in real time
discussing and/or debating discordant concepts	electronic critique box for students to post position papers then attach comments or questions to one another's documents
mentoring, questioning	e-mail, discussion boards, chat rooms, content annotation, for students to ask questions and receive answers from peers and the instructor
monitoring progress towards achievement of learning goals	drill and practice tutorials, online quizzes, discussion boards or Web servers for students to post their work and receive formative comments from others, tools for students to develop and maintain a portfolio of products

Table 3.
Developing Community Documents and Databases

Goals	Strategies	Materials	Tools
interpret, analyze	develop community documents and databases	case library, Web links	group question and annotation anchors, group concept maps, group Web editors, group data forms

desired student activity. Three instructional strategies that can be supported by emerging Internet tools include: developing community documents and databases, researching ill-defined problems, and creating course-related materials.

Developing community documents and database. As illustrated in Table 3, if faculty want students to correctly analyze and interpret novel situations, issues, or problems, they might select developing community documents and databases as an instructional strategy. A case library or database of external Web links could provide students with underlying content, but the mechanism by which students analyze and interpret the content would be provided by tools.

Using collaborative tools is a type of social constructivism whereby knowledge is generated through group activity. Individuals support one another in co-constructing the facts, knowledge, and processes of a content area or discipline (Morphew, 2000). Students working on group documents may reach a state of conflict that must be reconciled in the form of a solution. The solution represents a "...qualitatively different third perspective [combining] two opposing ideas into a coherent, higher-level idea" (Clements & Nastasi, 1992, p. 243). Students learn more when given tools to discuss and explain their own ideas and to develop and refine documents in groups (Vosniadou, 1994). Yet, online course management systems frequently promote an expert's point of view or direct knowledge dissemination. While discussion boards and electronic groups are available through some online course management systems, additional tools are needed for students to generate community documents and databases in the process of inquiry.

Online forms are one type of tool that allow students to develop community databases. Students from several schools or universities can work on a similar research project. Data is collected locally on a topic (e.g., pollution, wind, medical trends such as height and disease), then uploaded to the community database for all students to process, analyze, or practice statistics. Such projects can promote interdisciplinary connections and can boost student motivation and interest from involvement in a real research effort with valuable new findings. The GLOBE project involves K-12 students with local hands-on data collection of climate, water, biology, and geology data, numerical data reporting to online databases with other international classes, and analysis and interpretation of holistic trends. An evaluation of the project indicates students are not only motivated by such activity, but also learn to interpret data sets by forming hypotheses or explanations for anomalous findings (Means & Coleman, 2000).

A second tool category, Web annotation software, allows students to develop community documents and critiques. McHenry (2000) advocates the development of Web annotation tools that allow students to anchor questions to specific online content segments. Other students or faculty respond to these questions, creating a community Web of not only content but also responsive annotations. The Harvard Annotation Engine (Berkman Center for Internet & Society, 2000) and Page Seeder (Weborganic Systems, 2001) are two existing products that provide for basic Web page annotation. Annotation tools are not only useful for questioning and discussing course documents, but also for supporting class critique activities where students post Web reports and documents for evaluation by peers.

A third tool category, concept mapping software, allows students to co-construct community information Webs. Collaborative Webs allow students to investigate and explicate relationships, including: causal, correlational, or adversarial (e.g., "Here are some causes I found for the problem you mention." "Here is an alternate opinion for the issue you have described."). The Knowledge Forum software program (Learning in Motion, 2001) provides students with an elaborate bulletin board where notes or "posts" can be concept-mapped or con-

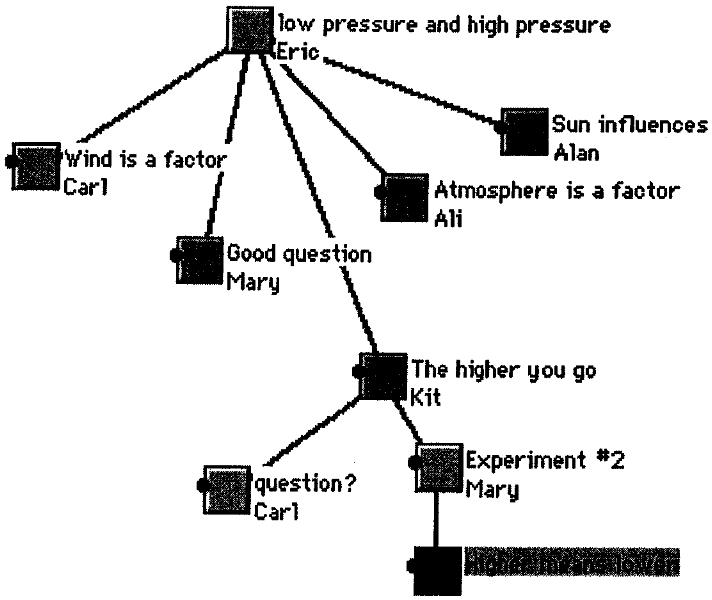


Figure 4. Knowledge Forum group inquiry

nected visually to other students' notes. Figure 4 illustrates a scenario in which one student posted a question regarding the causes of high and low pressure, and fellow students responded with potential answers, including the sun, wind, and atmosphere. Knowledge Forum also allows the instructor to develop lead-in-scaffolding statements that help students undertake specific inquiries (e.g., for medical problems, "My diagnosis is...," for debate problems, "Evidence I found to support this claim is..."). The Institute for Human and Machine Cognition (2000) provides a similar group concept-mapping program, CMap, for students and professionals to collectively map out components of a problem or issue. Figure 5 illustrates a powerful attachment function of CMap. Users are able to upload various media elements to a concept map's directory (e.g., video, audio, images, and Web links), and then attach icons to the appropriate point on the concept map to reference the media. The media elements can help to provide supporting documentation or evidence for a map component.

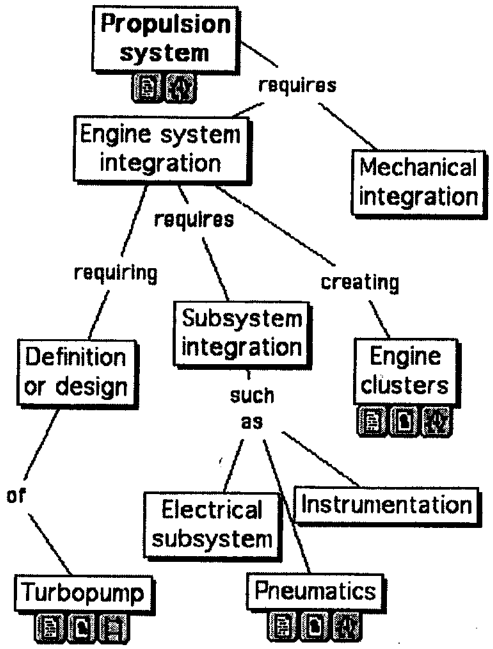


Figure 5. Concept Map with attached media

Finally, researchers have developed a fourth type of community tool that allows students to collectively own and edit a single document. The Swiki Swiki (Guzdial, in press) and Sparrow (Xerox Palo Alto Research Center, 2000) tools are sample programs in this category. A single Web page is developed and can be modified by others with proper permissions. Figure 6 (Chang, 1998) illustrates a Web page being modified by the Sparrow program. When coediting a community document, the storage of past products is important, so community processing and thinking may be analyzed over time.

In the tools described above, note how the privileges given to students vary from simply sharing data, to annotating and marking up an existing document, to attaching related media elements to existing documents, to visually mapping and relating comments together in some structure, to finally editing and completely changing one another's work.

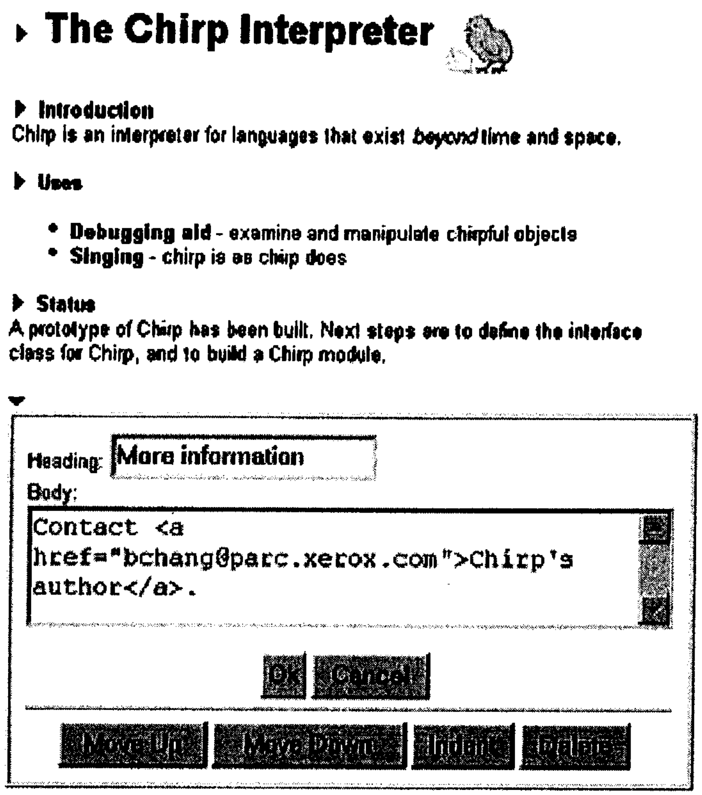


Figure 6. Sparrow Web document illustrating editable sections under "disclosure triangles"

Researching ill-defined problems. As illustrated in Table 4, if faculty want students to develop higher-order synthesis and evaluation skill, they might select student research into ill-defined problems as an instructional strategy. Problem-based learning (PBL) is perhaps the most familiar learning model promoting the use of ill-defined situations. Students frame problems in groups by evaluating their understanding against new information gathered. New solutions are eventually justified on the basis of synthesized evidence. At least two categories of tools are available to support group research into ill-defined

Table 4.
Researching Ill-defined Problems

Goals	Strategies	Materials	Tools
synthesize, evaluate	research ill-defined problems	library, Web links, online professionals	WISE, Sensemaker; VisIT; Artemis

problems: tools that scaffold problem-solving procedures, and tools that help students locate, store, and compile evidence related to their problem.

The Web-Integrated Science Environment (WISE) (Slotta & Linn, 2000) allows instructors to develop a problem-solving process and scaffold learners as they attempt to follow a series of steps (see Figure 7). Students are provided with a note-taking feature to participate in various processes (e.g., "state your hypothesis...") and to take general notes about Web pages accessed. Few, if any, online course management systems allow faculty to scaffold discipline-specific processes by developing a cycle of inquiry that calls upon and prompts students to use various tools in the system.

To support ill-defined problem solving, additional tools are available for students to collect and organize problem-related information. The VisIT tool (Beckman Institute for Advanced Science and Technology, 2000) allows students to conduct online searches, then visually group or arrange the returned search "hits" into new structures or concept maps. Figure 8 illustrates the result of a VisIT search on "human anatomy," and shows how the student can arrange the relevant hits onto a coherent background image of human arteries. Through VisIT, students can also attach notes to search hits, annotating their importance or relationship to other hits. Like VisIT, the Artemis tool developed at the University of Michigan (2000) allows students to collect and bookmark online information. With Artemis, students post "driving questions," then utilize folders that contain their questions to sort and compile relevant documents. Other tools useful for organizing online information include the Sensemaker tool developed at the University of California, Berkeley (Slotta & Linn, 2000). Figure 9 illustrates the Sensemaker tool and how a group of students have categorized Internet pages into problem-related categories (Slotta & Linn, 2000) (see Figure 9). As students learn more, they

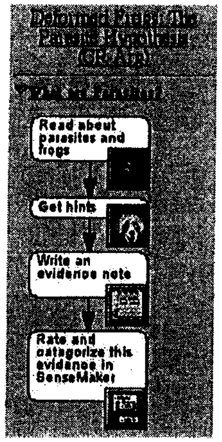


Figure 7. ***WISE online inquiry scaffolding***

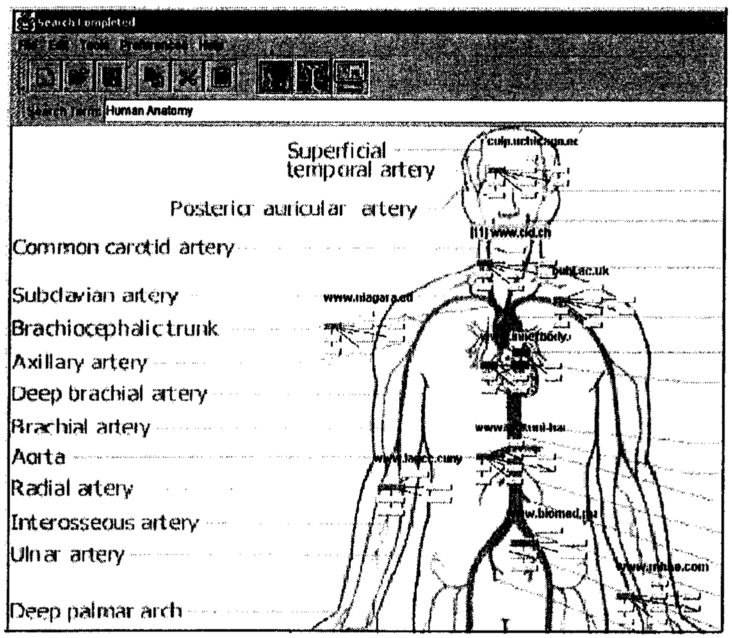


Figure 8. ***VisIT: Visualization of Information tool***

Table 5.
Creating Course-related Materials

Goals	Strategies	Materials	Tools
synthesize, evaluate	creating course-related materials	text, images, video, audio	Web page editors, authoring software, video editing software

can add or change categories to continue refining their mental model about a topic, concept, or problem. If students are dealing with controversies, they can use the tool to judge the weight of evidence for contrasting views and make decisions (e.g., "what is the best management plan based on the evidence gathered..."). Few online course management systems provide tools such as VisIT, Artemis, or Sensemaker, for students to collect and sort information into inquiry-relevant structures.

Creating course-related materials. As illustrated in Table 5, if faculty want students to develop higher-order synthesis and evaluation skill, they might also select creating course-related materials as an instructional strategy. Rather than accessing and reading material created by faculty, the idea of students learning by creating materials to teach others is known as constructionism (a subcategory of the more inclusive term "constructivism") (Jonassen, Myers, & McKillop, 1996). In constructionist activities, students use tools to design and structure their own scenarios, cases, computer programs, and representations. Jonassen et al. (1996) suggest constructionist activities "better distribute cognitive responsibilities between the learner and the technology":

> Rather than using the limited capabilities of the computer to present information and judge learner input (neither of which computers do well) while asking learners to memorize information and later recall it (which computers do with far greater speed and accuracy than humans), we should assign cognitive responsibility to the part of the learning system that does it the best. Learners should be responsible for recognizing and judging patterns of information and then organizing them, while the computer system should perform calculations, and store and retrieve information. (pp. 96-97)

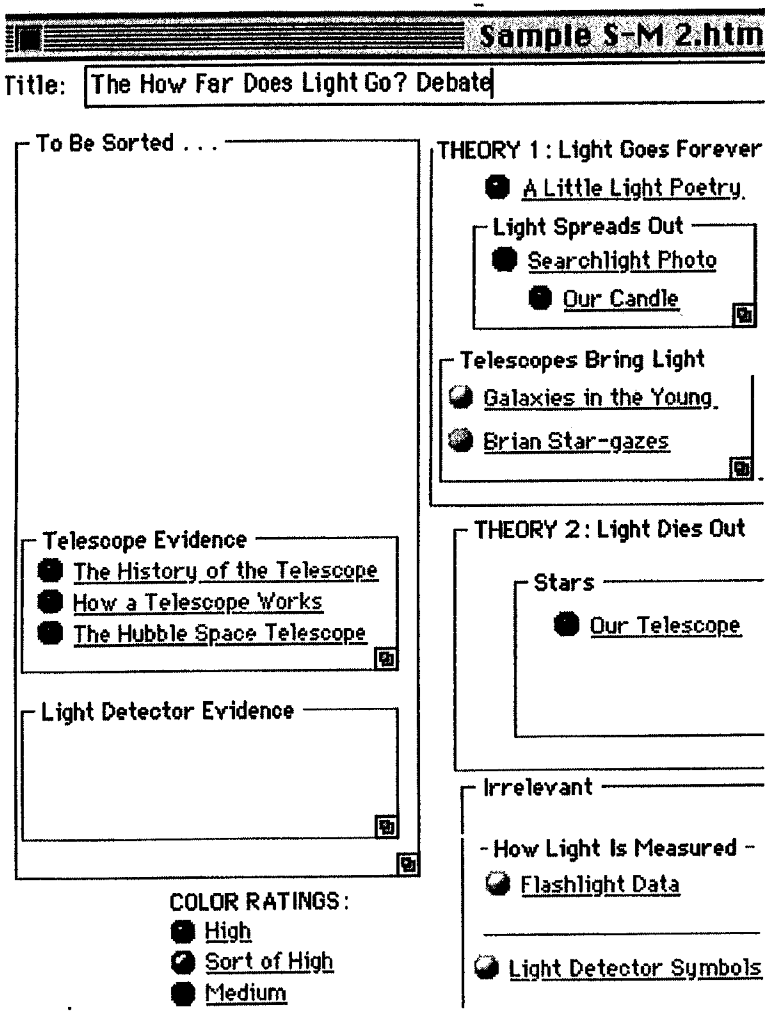


Figure 9. Sensemaker tool for organizing online evidence into categories

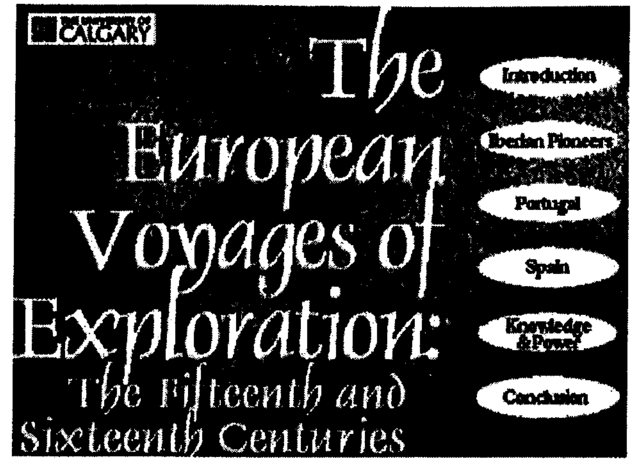


Figure 10. Multimedia history tutorial

After students research a topic, they might use Web development tools to develop new Internet materials such as course-related multimedia tutorials. Figure 10 illustrates the cover page from a student-developed Web tutorial at the University of Calgary (Applied History Research Group, 2000). Few online course management systems provide students with internal Web editing ability, where course text, images, or other external media can be represented in new forms. Yet, transforming information into Web documents can promote learning, as the task requires student designers to make decisions about important information to include, how to divide and chunk information, and how to interrelate the information (Lehrer, 1993). After course-related materials are created, students can critique one another's work or use the artifacts to engage in debate. Further, the artifacts created from student synthesis can be used as source material for future sections of the same course. As Gilliver, Randall, and Pok (1999) suggest, the product or terminal outcome for one group of learners, synthesis, becomes the introductory knowledge component for new students to study. In this way, constructionist tools can help transform Bloom et al.'s (1956) original taxonomy of skill into a continuum of supporting processes.

SUMMARY

TWO CATEGORIES OF TOOLS are available for Web-based courses: development tools for faculty to create and deliver content online and active learning tools for students to engage in higher-order information processing (e.g., analyze, synthesize, evaluate). Most popular online course management systems focus heavily on faculty dissemination tools while neglecting to provide students with adequate tools for inquiry and problem solving. Salomon (2000) suggests such domestication of new technologies to teach in standard or ongoing, traditional modes results in a technological paradox:

> A most powerful and innovative technology is taken and is domesticated such that it does more or less what its predecessors have done, only it does it a bit faster and a bit nicer. Consequently, nothing really happens, which comes to prove what skeptics have argued all along and what misguided research tends to show: Technology makes no difference in learning. But of course it cannot make a difference since it has been domesticated to be totally subservient to the ongoing practices.

Faculty should analyze their learning goals, select appropriate strategies to facilitate their goals, then seek tools to support their strategies. Only those online course management systems that contain the necessary features to enable one's strategies should be used. Effective strategies should not be sacrificed to fit the existing features of an online course management system. If the necessary tools are not prepackaged in a system, faculty should consider using other external tools or developing new support structures to promote higher-order learning.

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