WEB SITE AND SOFTWARE ANNOUNCEMENTS

A Web site in cognitive science

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A Web site (<http://web2-pc.uncc.edu/cogsci>) has been established to support an interdisciplinary course in cognitive science. The modules include introductory reading material, interactive exercises/virtual laboratory, and pointers to existing material on the Web. Our approach to using the Web in support of instruction differs from distance learning initiatives because it is centered on an instructor and classroom experiences. The Web-based modules are used to supplement classroom lectures and provide an interdisciplinary perspective.

We have established a Web site (<http://web2-pc.uncc.edu/cogsci>) that provides educational materials for an introduction to cognitive science course. The Web site is organized into modules centered on 14 core topics that provide an interdisciplinary perspective and supplement classroom lectures with reading material and virtual laboratory experience.

Introduction to Cognitive Science has been taught over the past 5 years as a three semester hour course, and each semester the course has closed with a capacity enrollment of 80 students. An instructor from one of the contributing disciplines teaches the course with the assistance of guest lecturers. Students take the course for elective credit in either computer science or psychology, and it is required for those who are minoring in cognitive science. The course draws a broad mix of upper division students from psychology, computer science, philosophy, and linguistics.

Although course evaluations show a favorable student reaction (77% indicated an interest in taking more courses in cognitive science), students consistently note a problem with the textbook. The two textbooks (Green et al., 1996; Stillings et al., 1987) that we used in different semesters were rated for usefulness on a 7-point scale (1 = *not at all useful* and 7 = *very useful*). Average ratings for both books were 3.4, and 41% of the students expressed difficulty with the reading material. When asked to describe the ideal textbook, students indicated the desire for a textbook that was "a little less dense," that had "more examples and real-world applications," was "more connected and inter-related," and "informative to anyone

without previous cognitive classes." Some of the problems with the textbook stem from the fact that the students come from such varied backgrounds that many do not have a thorough enough context with which to understand the contemporary research findings that are presented.

The materials that are available from our Web site were developed to address the student concerns and are used in lieu of a textbook to supplement classroom lectures. The modules differ in several fundamental ways from the cognitive science textbooks that are currently available. First, they aim for an introductory approach to each of the topics, and readability is an important criterion. The textbooks that have been used in the past (Green et al., 1996; Stillings et al., 1987) have helped to narrow down the focus of study to a core set of interdisciplinary topics, but course evaluations have shown that students have difficulty relating to much of the material. In developing our modules, we have been selective in the choice of material and have aimed for an introductory rather than a comprehensive approach. References are provided at the end of each of the modules so that interested students can read further on their own. The first set of evaluations from our external reviewers and from the students who used the materials during the Spring 2000 semester indicate some success with this objective. Table 1 presents student ratings of readability on a scale from 1 to 5 (where 1 = *easy* and 5 = *difficult*). Average ratings were 3 or less for the six modules that were pilot tested. Moreover, external reviewers for each of those modules have consistently noted that the writing style is appropriate for an introductory course.

Second, the presentation of the material takes full advantage of the multimedia capability of the Web. When appropriate, pictures, sounds, and dynamic elements embedded in Java scripts accompany text. The Vision and the Brain Mechanisms modules use figures extensively to illustrate the points that are discussed.

Third, whenever possible, interactive exercises are used to provide an example or application of the concept that is being discussed. For example, the Consciousness

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Table 1
Student Ratings for the First Six Modules on the Web Site

Module	N	Time Spent		Readability		Usefulness	
		M	SD	M	SD	M	SD
Consciousness	67	2.07	1.0	2.86	0.5	2.25	0.6
Brain mechanisms	24	2.2	0.9	3.08	0.3	2.3	0.6
Vision	24	2.1	0.8	3.17	0.6	2.34	0.5
Language	60	1.8	0.9	2.96	0.7	1.92	0.6
Memory	55	1.33	1.1	2.16	1.3	1.62	1.0
Cognitive development	55	1.18	1.1	2.09	1.4	1.58	1.1

Note—Time spent with the module: 0 = 0, 1 ≤ 30 min, 2 = 30–60 min, 3 = 61–90 min, 4 ≥ 90 min. Readability: 1 = *easy*, 3 = *average*, 5 = *very difficult*. Usefulness: 1 = *not at all*, 2 = *somewhat*, 3 = *very useful*.

module includes a demonstration of the phi phenomenon that permits students to vary the timing and the color of the display in order to optimize their phenomenal experience. After working with the demonstration, students are invited to write about their findings through a bulletin board. Similarly, the Memory module encourages the students to test the limits of their working memory and to measure the size of their memory.

Varying degrees of interactivity are used throughout the Web site. In some cases, a simple Java script is built into the page to allow students to view a visual perception demonstration at a button press, or a mouse over command is used so that, when a student moves mouse over a figure, hidden text becomes visible. In other instances, Java applets are used to provide a stand-alone exercise. We take advantage of the flexibility in the Web for presenting information by providing virtual laboratory experience and by using discussion forums so that students can interact as they read the assigned material and study for the class. In addition to the educational advantage for the students, a virtual laboratory is a cost-effective way for an institution to provide hands-on experience in large lecture classes.

Fourth, we use exercises and other materials that are readily available on the World-Wide Web by adding hyperlinks from our text to existing Internet sites. A Java script is used to open the external Web site into a new window on the desktop. When the student is finished, he or she can return to the original page by closing the window. Demonstrations from Kiser's (1996) Joy of Visual Perception (<http://www.yorku.ca/research/vision/eye/>) and Cognitive Psychology Laboratory (1999) (<http://coglab.psych.purdue.edu>) are two of the many Web sites that are linked.

The challenge of teaching an interdisciplinary course in cognitive science is to make sure that the students are exposed to the varied teaching styles and strengths that are contained in each of the contributing disciplines. It is important, for example, that students be exposed to computer science's emphasis on problem solving, psychology's emphasis on observation and experimentation, and philosophy's discussion and debate. With a single instructor, it is difficult to ensure a broad perspective. A recent article (Schunn, Crowley, & Okada, 1998) has highlighted the im-

portance of work coming from a conjunction of multiple disciplines as shaping the emergence of a new discipline called cognitive science. An interdisciplinary perspective to the presentation of the material is ensured because the modules are authored and reviewed by faculty from psychology, computer science, linguistics, and philosophy. Moreover, some modules, such as Human and Machine Learning, Consciousness, and Speech Perception are actually co-authored by faculty from different disciplines.

Description of the Web Site

The Web site is available at <http://web2-pc.uncc.edu/cogsci>. Figure 1 shows the main page with the list of available modules in the left frame. When complete, 11 of the modules will deal with core issues (What Is Cognitive Science? Memory, Machine Learning, Problem Solving, Decision Making, Brain Mechanisms, Vision, Knowledge Representation, Speech Production and Perception, Cognitive Development, and Language), and three others will focus on contemporary topics such as consciousness, reading, and machine intelligence.

Each module contains features for enhancing the student's learning. References and further readings are included with a glossary and self-quiz so that students can test their mastery of the concepts presented. Links on the first page of each of the modules provide students with e-mail access to the faculty who developed the modules. Comments and questions can be forwarded in this way or through the on-line survey that is on the main page.

The Web site is under development by an interdisciplinary project team. We are in the second year of a 2.5-yr effort to develop, test, and evaluate the Web-based educational material. Our development effort includes extensive evaluation. When a module is placed on the Web site, it undergoes internal review by at least two members of the project team faculty and it is then sent for external review to two members of our Board of Advisors. The Board of Advisors consists of 10 faculty members who are involved with cognitive science courses at other universities, are willing to review the modules as they are developed, and encourage their own students to use the materials as either supplementary or required reading.

The Development Effort

Staff and student assistants facilitated the development efforts of the 9-member faculty team. Professional staff with instructional design expertise created the main page and a series of templates that are used to develop the pages of each of the modules. The templates provide a common interface so that formatting details and navigation are consistent throughout the site. Faculty created their respective modules by opening the page templates into an html editor (e.g., Netscape composer) and adding content that is appropriate for each of the topics. Students, trained in either Java scripting or computer-aided drawing, developed the figures and interactive exercises.

Figure 1. Main page from the Cognitive Science Web site (<http://web2-pc.uncc.edu/cogsci>).

Evaluation

Table 1 summarizes student reactions to the first six modules that were developed for the Web site. When tested on the topics covered in the modules, students were asked to rate each module on readability and usefulness and to indicate the amount of time they spent with the module in preparing for course exams. Responses showed that 100% of the students accessed the Web site in order to study for the course. Although some just wanted to print the material for study off-line (30%–40%), the majority spent 30–90 min per module, working through the interactive exercises from the Web. Ninety-four percent of the students indicated that the material was useful and quite readable. Comments from the students regarding various navigation features of the modules will form the basis for revisions of the site. When the students were asked at the end of the semester to compare the usefulness of the Web site with that of the textbook by Green et al. (1996), 27% indicated that it was as useful as the textbook and 62% rated it as more useful.

Regression analyses were used to determine whether time spent with the modules and frequency of class attendance predicted performance on the tests and the final grade. The final grade was found to be significantly related to frequency of class attendance [$r(66) = .37, p < .01$], but no significant relationship was found between the final grade and time spent with the modules [$r(66) = .08, p = .50$]. Box plots in Figure 2 show how the amount

of time spent with the modules and the frequency of class attendance varied for students in each of the grade categories. Over half of the students who received a grade of A in the course spent more time with the modules than did the students who received a grade of B or C. However, there were a few A students who spent minimal time with the modules. Attending class was more strongly associated with course grade than was time spent with the modules.

Because the students were using the Web site during its first year of development and material was being added as the students were taking the course and the Web site material was being used in conjunction with a standard textbook (Green et al., 1996), it is not surprising that the students did not depend on the Web site for learning as extensively as they did the classroom lectures. Reliance on self-report data may have also affected our pilot results. The next time that the course is offered (Spring 2001), the site will be complete and students will use it in lieu of a textbook. We expect that the data collected in the Spring 2001 semester will be a more representative sample of the usefulness of the Web site than is the pilot data. In addition to the survey data, we will also collect data from the Web site itself to monitor students' use and navigation habits.

CONCLUSION

Using the Web in the manner described has a number of advantages. Most important is the ease with which project

Figure 2. Box plots showing the relationship of course performance (as measured by the student's final grade) with days of attendance (top panel) and total time spent with the Web site (bottom panel). Total time was calculated for each student by summing the ratings of time spent with each of the six modules.

team members can revise and update their material. Unlike with a textbook, which has an elaborate process for printing and publishing, keeping the educational material up-to-date is as easy as changing instructor notes. Because we relied on templates to dictate the look and structure of each of the modules, it was easy for the faculty to concentrate on content rather than on the appearance of the site. Project team members can simply copy and paste their content inside a series of prestructured pages. Once the interface is built and members of the project team learn to use an html editor (e.g., Netscape composer), coding, editing, and updating the material in each of the modules can be done page by page at the discretion of each faculty member.

Another noticeable benefit of this project is that it has provided the opportunity for faculty development for the project team members. A number of the modules were co-authored by faculty from different disciplines, and, prior to external review, each module was the focus of a seminar discussion by the entire project team. Discussions over the content of the modules have offered a wealth of opportunities to resolve inconsistencies between disciplines over cognitive science issues. Also, by the end of

the project, each member of the project team will have become proficient in html editing and Java scripting.

People have responded favorably to educational material presented over the Web. Initial reactions from the students enrolled in the Cognitive Science course and from members of the Board of Advisors have been quite positive. Students have frequently commented that the content material is easier to understand than a textbook and that they appreciate the ready availability of the interactive exercises. Further work is needed, however, before we can be sure that these materials provide the same or better background readings as the textbooks that are in current use for students enrolled in the Introduction to Cognitive Science course.

Although the materials were developed for use in a specific course, the Web-based delivery allows students and faculty in other courses related to cognitive science full use of the site. The site is accessible to anyone with Internet access through a guest log-in procedure.

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