Web-Based Learning Environments Guided by Principles of Good Teaching Practice

John F. Chizmar and Mark S. Walbert

In this article, we describe the preparation and execution of a statistics course, an undergraduate econometrics course, and a microeconomic theory course, each of which uses Internet technology as an integral part of the delivery of the course. We address the pedagogical and technical issues that must be resolved to achieve each of Chickering and Gamson's (1987) seven principles for good teaching practice using this medium. Pedagogical issues are paramount if the goal is to achieve the best teaching practice. Of equivalent importance, however, is choosing a technology that will support the chosen pedagogical strategy and work well over the World Wide Web.

We make extensive use of the Web through an on-line syllabus—a series of Web pages that

- distribute information to students—the course contract (syllabus), gradebook, and assigned articles
- collect information from students—the one-minute paper, classroom opinion polls, the results of sampling experiments
- link students to other sites—data sets and articles relevant to the class
- assists students to discover important concepts on their own—Excel workbook, "labs," and tutorials.

Chizmar teaches undergraduate statistics and econometrics courses. The statistics course is designed to emulate the premise of an unconventional, National Science Foundation (NSF)-funded statistics course called Chance (Snell and Finn 1992). It enables students to learn statistical reasoning by studying important current economic controversies whose understanding requires a fundamental knowledge of statistical reasoning. Walbert teaches an intermediate microeconomic theory course in which students work collaboratively to solve problems. During class time, students download a spreadsheet file from the course Web site that contains a key graphical model that they manipulate to solve problems. All three courses meet in a computer classroom.

Most of the time, our role is to act as guide or coach, monitoring student understanding, asking and answering questions, leading discussions, suggesting ways to remove blocks to learning, and, when necessary, delivering mini-lectures.

John F. Chizmar *is a professor of economics (e-mail: jfchizma@ilstu.edu) and* ***Mark S. Walbert*** *is an associate professor of economics at Illinois State University.*

SEVEN PRINCIPLES OF GOOD TEACHING PRACTICE

To help the reader understand how Web technologies can be used to enhance the quality of student learning and increase active participation by students, we discuss our experiences with creating learning strategies that used Web technologies to achieve Chickering and Gamson's seven principles. We emphasize our belief that the choice of a particular technological tool must be driven by pedagogical considerations. Technology must not be preeminent and must not be used for its own sake. Rather, as stated by Chizmar and Williams (1997, 3), "The pedagogy must drive the choices of instructional technology, not the other way around."

As long ago as 1972, the Carnegie Commission on Higher Education (*The Fourth Revolution*) created the following litmus test for the best use of instructional technology:

- the teaching-learning task to be performed [is] essential to the course to which it is applied, and
- the task could not be performed as well—if at all—for the students without the technology.

Encourage Contacts Between Students and Faculty

Chickering and Gamson's first principle can mean student-to-student as well as student-to-faculty contacts. One way to encourage student-to-student interaction is with "think-pair-share." We both use an electronic version of think-pair-share in our courses. For example, to help students clarify their thinking after we discuss a concept, we ask them to work in teams and to post a message in NetForum[1] (a Web-based threaded discussion application developed at the University of Wisconsin-Madison) that explains a particularly difficult concept, a *p* value for example. Students then read what other students have written and discuss differences or similarities with their teammates.

This version of think-pair-share is based on Meyers and Jones's (1993, 25) observation that

> when we direct students to write to each other, they usually write with more clarity and precision. By structuring our assignments in what writing teachers call a "rhetorical context," in other words, for a specific audience, situation, and purpose, we can free students from some of their misconceptions about college writing and help them write better.

The advantage of NetForum in this context is that students know that their message will be posted on the Web for the entire class—indeed, the world—to read. Klass (1995) has observed that when students write to a larger audience, in contrast to writing just to the instructor, their writing is substantially improved.

One way to enhance student-to-teacher interaction is with the one-minute paper (Cross and Angelo 1988; Light 1990; Chizmar and Ostrosky 1998). The one-minute paper is designed to obtain regular feedback from students. In the final minute or two of class, the teacher asks students to respond to two questions

concerning that day's class: What was the most important idea presented and what was the least clear idea. This exercise encourages contact between students and the instructor by providing the instructor with regular feedback concerning what students are learning and how well they are learning it and by providing students with a mechanism that gives them control over their learning.

We have incorporated the one-minute paper into a Web form (using a CGI script) that students complete at the conclusion of every class (Figure 1). The form creates a text file of the students' responses that can be easily analyzed in any word processor or HTML editor.[2] The edited compilation of responses is then posted to the course NetForum, typos and spelling errors included (Figure 2). A discussion of the "mud" listed by the students serves as a starting point for the next class. Furthermore, because the form also asks each student to provide an e-mail address, we can respond immediately via e-mail to any student whose understanding of the material seems particularly muddy.

FIGURE 1
One-Minute Paper Form

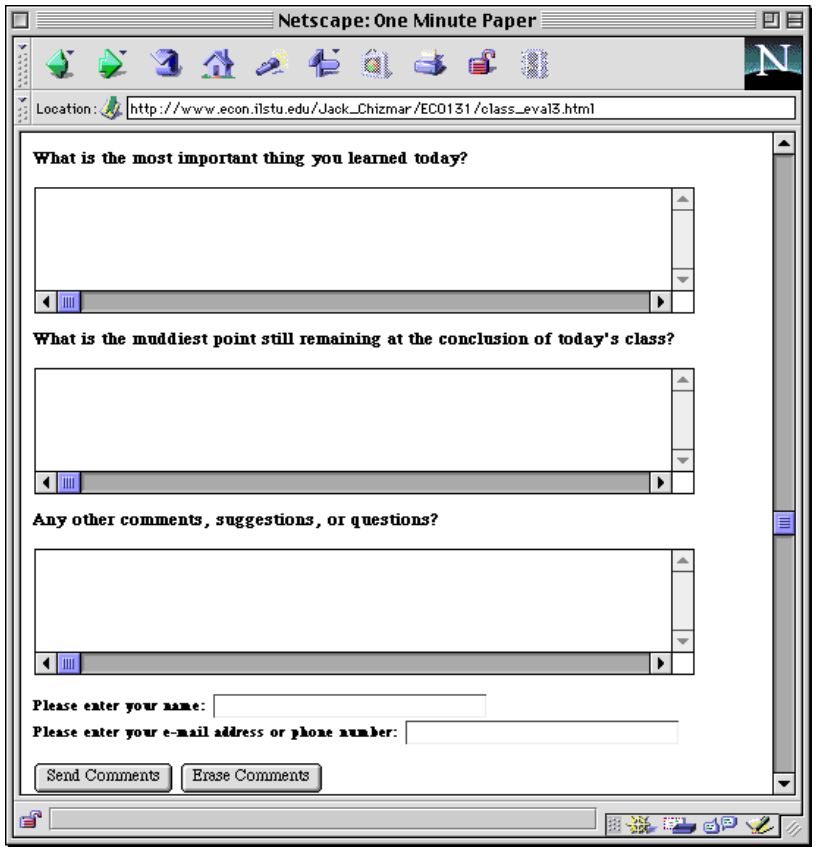
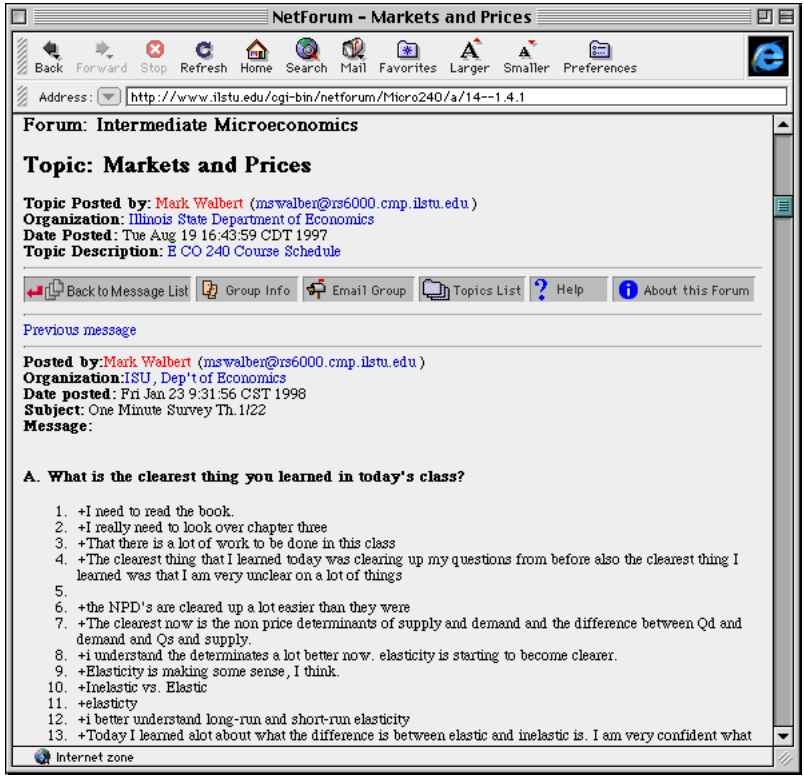


FIGURE 2
One-Minute Paper Posting in NetForm



We are convinced that using the one-minute paper has improved student learning in our classes. Indeed, Chizmar and Ostrosky (1998) have concluded that using the one-minute paper in the principles of economics course increased economic knowledge by approximately 6.6 percent.[3]

Use Active Learning Techniques

Most of our efforts at incorporating Web technology into instruction have focused on this second principle of good teaching practice. Chizmar uses a collaborative classroom/laboratory approach in which Web technology is used to substitute hands-on activities for the lecture (Cobb 1993; Rossman 1996). The expository material is broken into a series of hypertext labs. The labs require students to collect and produce data, make predictions, read about important economic controversies, discuss findings, analyze data, access the vast array of data available on the Web, conduct simulations, and write explanations.

Each lab has its own Web page linked to the on-line syllabus and to a check page that provides instantaneous feedback. The labs guide students, working in

teams, to discover important statistical and econometric concepts on their own and challenge students to demonstrate their understanding of statistical and econometric issues by posting explanations and interpretations in NetForum. For example, Figure 3 shows a lab that introduces students to the scatter plot. Students use this tool to begin to understand the issues in an important economic controversy—whether, as has been suggested by economist Ray Fair (1996), a simple regression model based on economic indicators can give more reliable predictions of election results than opinion polls. Most important, students discover for themselves how to interpret a scatter plot and are asked to post a message from their team in NetForum that describes, in words their classmates will understand, the relationship between the two key variables. The subsequent lab builds on students' understanding of scatter plots and uses a simulation, written in XLISP, found on the Web to help students discover, on their own, the properties of the correlation coefficient.[4] Other labs ask students to travel the Internet to find interesting data at other Web sites.[5]

In the intermediate micro course, students retrieve Excel workbooks from the course Web site at the beginning of each class. Each of the workbooks contains

FIGURE 3
Lab 6a: Graphical Displays of Association

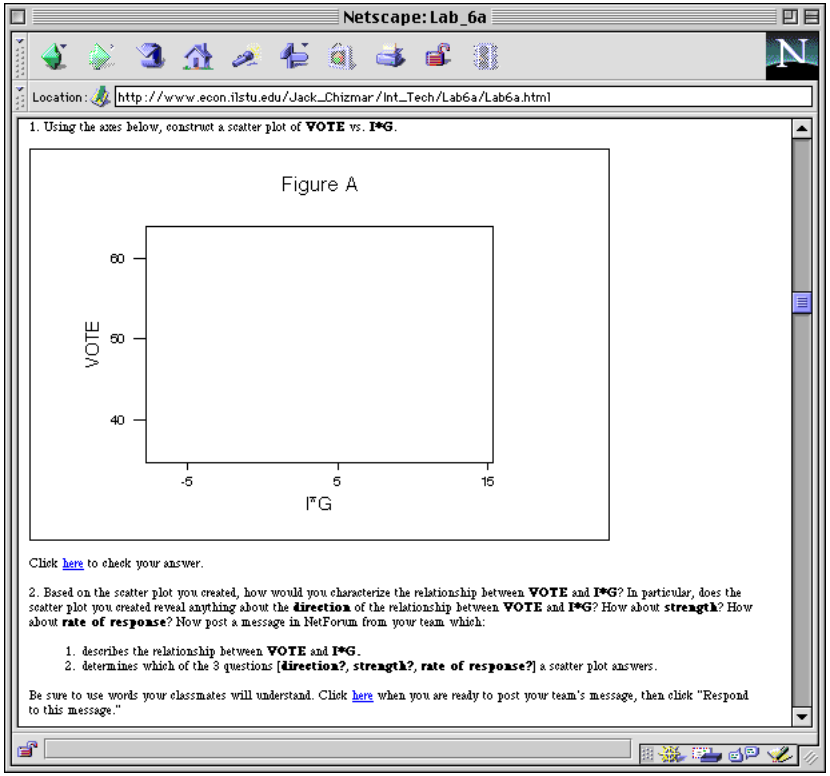
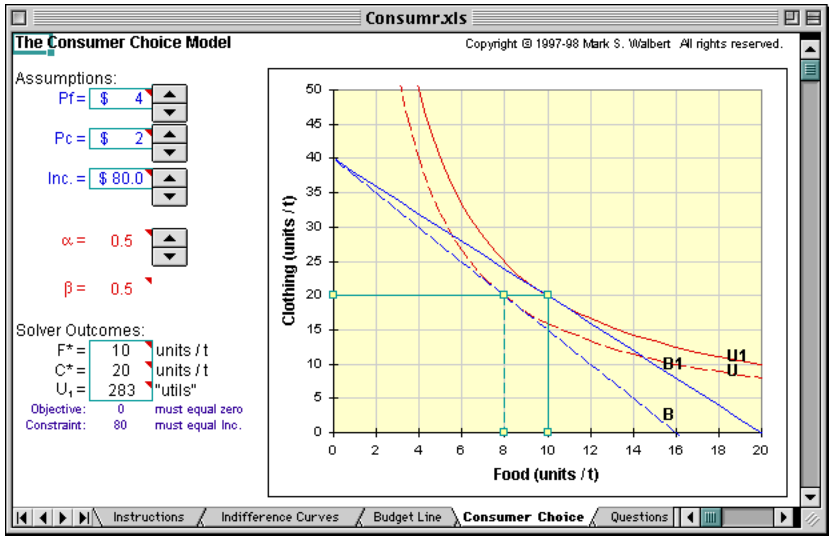


FIGURE 4
Consumer Choice Model



a worksheet of instructions and one or more graphical models. A third worksheet contains a set of questions that guide the students' inquiry into how a microeconomic model works and how changes to the underlying variables affect the result. For example, when studying the consumer choice model, students download an Excel workbook that contains worksheets on Indifference Curves, the Budget Line, and Consumer Choice. The Consumer Choice worksheet is shown in Figure 4. The five model parameters are shown on the left-hand side of the worksheet. Below them are the mathematical results of the consumer's constrained optimization model.[6]

Students use the Indifference Curves worksheet to alter the parameters in a Cobb-Douglas utility function. This manipulation allows them to visualize, for example, how changing a parameter value in the utility function changes the slope of an indifference curve. Similar insight into the construction of the consumer's budget line is gained by manipulating product prices or income and viewing the changes to a graphical model on the Budget Line worksheet. Subsequently, students use the Consumer Choice worksheet to alter any one (or more) of the five parameters affecting the buyer's optimum choice. By naming cells in the worksheet and using Excel's Solver add-in, students can set up the constrained optimization problem in English and use Excel to complete the model's calculations.[7] This process contributes to students' understanding of the constrained optimization problem.

The statistics labs, tutorials, intermediate theory problems, and Excel workbooks can all be accessed, anywhere, anytime, through the course online syllabus. Using any standard Web-browser, students can retrieve data files that support the

labs (in either MacOS or Windows95 format) by linking to a data files retrieval page using a Web-browser's helper applications facility. Students can post questions and interact (and, perhaps even collaborate) with each other and with the instructor using NetForum. Students can check each week's outline and assignments and a summary of the one-minute paper responses from the previous class using NetForum. Students can check their grades via the on-line gradebook.

Develop Reciprocity and Cooperation Among Students

In spring 1997, using the lab Web pages discussed previously, Chizmar offered the statistics course concurrently to two groups—an on-campus classroom group of students and an on-line Internet group. The contrast between these two settings illustrates the importance of Chickering and Gamson's third principle. The on-line students were connected solely through Internet services and never met physically with the instructor at any time during the semester. The on-campus students attended class in a classroom computer-lab setting where they had access to the same Internet resources as the Internet students. The on-campus course was identical in every way to the Internet course with two exceptions—the ubiquitous presence of the instructor in the on-campus course and the absence of cooperation among students in the on-line course. On-campus students completed lab assignments synchronously in teams and had the benefit of help from a teammate and/or the instructor just when they needed it. In contrast, on-line students completed the lab assignments asynchronously in the privacy of a dorm room or apartment and could seek help only by posting a message in NetForum and waiting for a reply.

Simple end-of-course data reveal that Internet students achieved lower cognitive gains than their on-campus counterparts.[8] Chizmar attributes the superior performance of the classroom students to access to the instructor and, important in this context, to cooperation with fellow students, both facets unavailable to on-line students.

Give Prompt Feedback

According to the *First Report of the Harvard Assessment Seminars* (Light 1990, 31), "students overwhelmingly report that the single most important ingredient for making a course effective is getting rapid response on assignments and quizzes." One way to use technology to give students quick and detailed feedback on their work, Chickering and Gamsan's fourth principle, is by posting answer keys within a few hours of collecting weekly quizzes or problem sets. Each answer key is posted on the course Web site and contains suggested answers (including graphs or equations) to each question.

One of the benefits of having students work with spreadsheet-based graphical models is the immediate visual feedback they offer. Excel offers the additional benefit of allowing students to set up an algebraic problem with one unknown and use the Goal Seek feature to find the optimum value.[9]

Another way to use Web technology to give prompt feedback is through hyper-

text. Chizmar's tutorials and labs are all hyperlinked to each other, in essence, providing a hypertext textbook. The tutorials and labs employ a consistent format—each main text page is linked to a help page that provides prompt feedback to questions raised on the main page. Hyperlinks are provided in tutorials that link to relevant labs. Hyperlinks are also provided to references of concepts previously covered.

Tutorial 16, for example, provides continuing feedback by beginning with a question leading up to the central-limit theorem that is based on students' work with the sample means in the immediately preceding tutorial. Tutorial 16 also provides links to labs designed to reveal how the mean behaves. The lab exercises use a format that, after every step, invites students to "click *here* to check your answer," thus providing prompt feedback just at the moment it is needed.[10]

Giving electronic quizzes is another way to use Web technologies to give prompt feedback. Chizmar experimented with Java-generated quizzes. However, he abandoned this effort in favor of creating a mastery homework system using Mallard, an ingenious Web-based system for asynchronous, interactive learning developed at the University of Illinois.[11] Mallard exercises use a combination of HTML tags and syntax idiosyncratic to Mallard. Mallard not only immediately assesses the correctness of a response to an on-line exercise, but it can be programmed to provide hints and/or explanations concerning why an answer is incorrect. Exercises are submitted and graded on-line, and the Mallard system then records the student's grade in its gradebook module. Furthermore, the system provides the instructor with detailed student grade information, for example, the number of times a student repeats a homework assignment.

Mallard can be programmed to randomly generate and select questions for a quiz from a designated pool of questions. As a result, a student will be quizzed using a different set of questions for the same concepts each time that he or she repeats the homework assignment. Because the gradebook module gives instructors complete control over grading policies, including late penalties and the number of times a Mallard exercise can be repeated for credit, Mallard can be used to create a mastery homework system.[12]

Emphasize Time on Task

Chickering and Gamson (1987, 3) argue in their fifth principle that "There is no substitute for time on task." Almost all computer-assisted instruction requires that students spend time on learning. However, technology can also be used to extend learning beyond the classroom walls. Walbert uses NetForum to continue classroom discussions of controversial topics. For example, after Princess Diana's untimely death in the fall of 1997, Walbert posted a link to an article entitled "The Faustian Bargain" (*The Economist*, September 5, 1997, 21–23) on his Web site. After devoting class time to a discussion of the economics of fame, students were asked to post a response in NetForum to a question concerning the economics of fame. This assignment generated the greatest amount of after-class discussion on NetForum during the semester.[13]

Communicate High Expectations

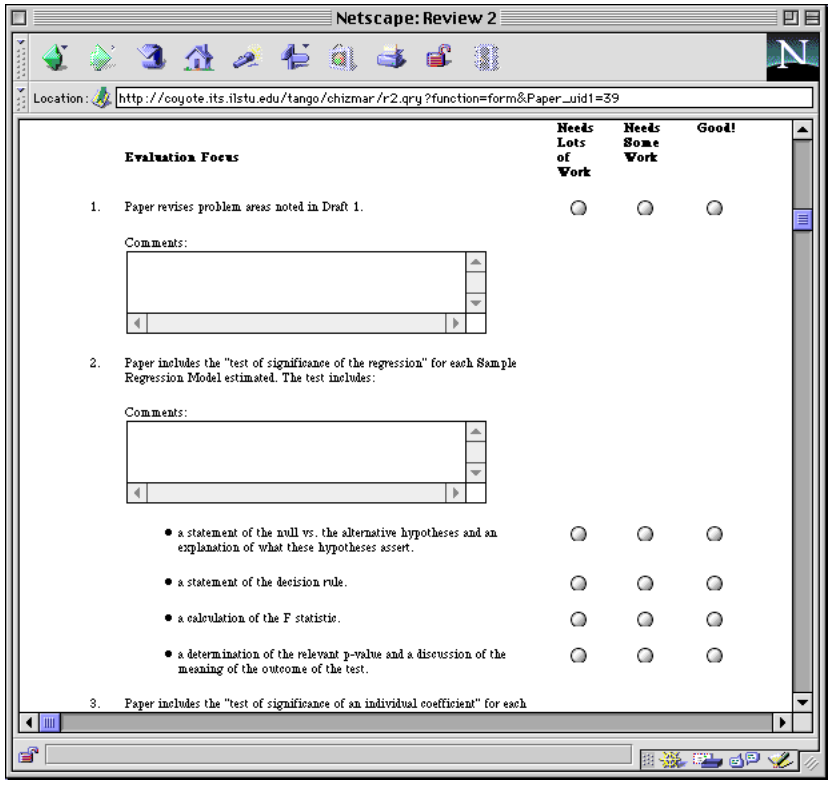
One way to communicate high expectations, the sixth principle, is through the use of a rubric (a.k.a., primary trait assessment). A rubric is an explicit statement of the criteria and standards to be used to evaluate student performance. According to Walvoord (1996, 9), a rubric "is assignment specific—for each performance the assessor builds a unique set of criteria—and identifies factors or 'traits' that will count for the scoring and then build a scale for scoring the student's performance with each trait." Thus, a rubric is an explicit statement of high expectations.

Web technologies can be used to communicate high expectations. Based on the premise that everyone likes to see their name in print, Chizmar uses Web technologies and the lure of publishing on the Web to stimulate students to create authentic finished work. From a list of several published articles that use data from the National Longitudinal Survey of Youth (NLSY), students choose an article to replicate.[14] Following a set of hypertext instruction pages, the student's first task is to extract (using the NLSY CD-ROM) a data file that replicates as closely as possible the data used in the chosen article and import the data into Minitab. Over the course of the semester, students write four drafts of the same paper. Each draft of the paper is accompanied by its own rubric. Each rubric states, in advance, the explicit econometric issues that a student must address to earn the grade he or she desires.[15] (See Figure 5 for the rubric to the second draft.) Based on a principle finding of the *Harvard Assessment Seminars* (Light 1990), that students feel that they learn best when they have a chance to revise and improve their work over time, the rubrics for drafts 2, 3, and 4 require students to revise problem areas noted in the preceding draft.[16]

The students publish their papers on the Web using a student-papers-publishing system created in Tango, a program that queries a database and creates a Web page showing the results of the query. To post a paper to the Web, a student completes a Web form that asks for the URL to his or her paper. The form automatically creates a link to his or her paper on the Student Paper page. The form also creates a link that invites anyone to "Click here to Post a Review" of a paper. The link brings up the rubric for that draft of the paper. Because the rubric is on the Web, anyone can use it to post a review. However, as a way to communicate high expectations, Chizmar requires his students to post a review of the third draft of a classmate's paper.[17]

Using the lure of publishing on the Web to motivate student learning was the primary impetus for the creation of the *University Avenue Undergraduate Journal of Economics (UAUJE)*, an on-line, student-edited journal dedicated to publishing student economic research of the highest quality. The *UAUJE* is the product of collaboration between a group of faculty members (the authors included) and students from Illinois State University and Illinois Wesleyan University with support from the Calvin K. Kazanjian Foundation. The *UAUJE* offers a significant opportunity for faculty members everywhere to use the lure of publishing on the Web to engage students in economic research.[18]

FIGURE 5
Rubric for Draft 2



Respect Diverse Talents and Ways of Learning

As we have demonstrated, Web technologies can be used to create an educational menu of diverse learning experiences that will allow students to discover and construct economic knowledge for themselves. Web technologies free students to pick and choose from the menu of diverse learning experiences to find the approach(es) that best fits the way they learn (the seventh principle). They can collaborate in groups or work alone. They can execute simulations, manipulate Excel workbooks, or conduct labs. They can listen to mini-lectures in class or review Web-based material out of class free of the constraints of place and time.

Web technologies also free teachers to explore roles other than lecturer. Teachers can be more the "guide on the side" and less "the sage on the stage." In fact, the on-campus vs. Internet-only parallel design of Chizmar's instructional experiment has provided him with an epiphany of teaching. Referring to this epiphany, Chizmar and Williams (1997, 10) state:

the best way to teach on-campus students is as if they are Internet students, i.e., as if the instructor is not there in the classroom with the students. On-campus students would then be forced to own their own learning through active learning pedagogies, which the instructor can augment at critical moments precisely because he/she is there in the classroom with the students.

CONCLUSION

Our experiences with using Web technologies to achieve Chickering and Gamson's seven principles of good teaching practice may assist others who choose to adapt technologic learning environments. Our story is intended to serve as a road map for others who seek to combine good teaching practice with Web technology. We offer you two viable models—a classroom/lab approach and an economic model manipulating approach using Excel—for classroom delivery of instruction using the Internet. We close where we began, with a reminder that technology should not be used for its own sake.

NOTES

1. More information about NetForum can be found at the following site: http://www.biostat.wisc.edu/netforum.
2. The Web-based form is only the latest incarnation of the one-minute paper. We first asked students to respond to the one-minute paper using paper and pencil and then using e-mail. The primary advantage of using the Web form is that it substantially reduces analysis time of the responses; for a class of 24 students, the analysis time was reduced from over one hour to less than 15 minutes.
3. An on-line version of the one-minute paper form can be viewed on the Web at http://www.econ.ilstu.edu/Jack_Chizmar/ECO131/class_eval3.html.
4. XLISP is a programming language developed at the University of Minnesota. See http://www.stat.umn.edu:80/ARCHIVES/archives.html.
5. Labs 6a and 6b and the NetForum for the statistics course can be viewed at the following sites:
   - http://www.econ.ilstu.edu/Jack_Chizmar/Int_Tech/Lab6a/Lab6a.html
   - http://www.econ.ilstu.edu/Jack_Chizmar/Int_Tech/Lab6b/Lab6b.html
   - http://www.ilstu.edu/cgi-bin/netforum/econstat/a/1.
6. This and other Excel workbooks can be downloaded from the Web at http://www.econ.ilstu.edu/Mark_Walbert/ECO240/240Templates.html.
7. For example, after lowering the price of food from $5/unit to $4/unit (Figure 4),the student uses Solver to find the new optimum values of Food (F_star) and Clothing (C_star). The formula for the tangency condition can be written in a cell and named Objective. The income constraint can be written in another cell and named Constraint. The student need only direct Solver to "Set the Objective equal to zero, by varying F_star and C_star, subject to the Constraint = Income."
8. At the beginning of the spring 1997 semester, Chizmar administered a 39-question survey designed to measure aptitude in statistical reasoning to students as a pretest. At the conclusion of the semester, he administered the same 39-question survey to students as a posttest. The data show that the on-campus students increased their performance by 15.8 questions, whereas the Internet students increased their performance by only 10 questions. This difference is both statistically and practically significant (p value = .0017). A similar difference was observed in final grades, with on-campus students averaging a letter grade higher than Internet students.
9. Furthermore, Excel's cells can be named. For example, suppose cell A1 contains a numerical value for Price, and cell A2 contains the formula for the difference between the quantity demanded and quantity supplied at that price. By naming cell A1 Price and naming cell A2 QD_QS, the student can ask Goal Seek to find Q such that QD_QS = 0 by varying Price.
10. Tutorials 15 and 16 and Lab 9b can be viewed on the Web at the following sites:
    - http://www.econ.ilstu.edu/Jack_Chizmar/Int_Tech/random/Tut15_clt.html
    - http://www.econ.ilstu.edu/Jack_Chizmar/Int_Tech/random/Tut16_pdq.html
    - http://www.econ.ilstu.edu/Jack_Chizmar/Int_Tech/Lab9b/Lab9b.html.

11. A Mallard Nestpage can be viewed at : http://www.cen.uiuc.edu/ Mallard/.
12. An example of a mastery homework quiz can be viewed at http://wolf.its.ilstu.edu:2000/eco131/. When prompted for ID, use "Inst_Tech"; when prompted for password, use "Pittsburgh." After the Mallard home-page displays, click on the link to the Lessons Page. Then click on the link to "Homework 1:Describing the Shape of Data."
13. The question and resulting student replies can be viewed at http://www.ilstu.edu/cgi-bin/netforum/Micro101/a/14—1.4.1.
14. Chizmar chose published articles that used data from the NLSY for two reasons. First,the NLSY data are inherently interesting to students because they concern the problems and issues facing young people as they move into the world of work. Second, many of the research papers that use data from the NLSY use a human capital framework, which, because it is not overly mathematical,is accessible to undergraduate students.
15. The rubric makes the job of ultimately grading students'papers much easier, precisely because the grading criteria have been stated explicitly in advance.
16. The hypertext instruction pages and the paper publishing system can be viewed at:
    • http://www.econ.ilstu.edu/Jack_Chizmar/ECO289/Paper_Procedures/pap_procedures.html
    • http://coyote.its.ilstu.edu/tango/chizmar/list.qry
17. An example of a student review of a paper can be viewed at http://coyote.its.ilstu.edu/tango/chizmar/list.qry. After the page displays, open any Draft 3 paper. The reviews are listed at the bottom of the page that opens subsequently.
18. The UAUJE can be viewed at http://www.econ.ilstu.edu/Econ_Web_Pages/EconJournal/Splash.html.

REFERENCES

Carnegie Commission on Higher Education. 1972. *The Fourth revolution: Instructional technology in higher education.* Berkeley, Calif.: Carnegie Commission.

Chickering, A. W.,and S. C. Ehrmann. 1996. Implementing the seven principles: Technology as lever. *AAHE Bulletin* 49 (2):3–6.

Chickering, A. W., and Z. Gamson. 1987. Seven principles for good practice in undergraduate education. *AAHE Bulletin* 39 (7):3–7.

Chizmar, J. F. and A. L. Ostrosky. 1998. The one-minute paper: Some empirical findings. *Journal of Economic Education* 29 (Winter):3–10.

Chizmar, J. F., and D. B. Williams. 1996. *Altering time and space through network technologies to enhance learning.* Paper presented at CAUSE97, December 1997, Orlando, Fla.

———. 1997. Internet delivery of instruction: Issues of best teaching practice, administrative hurdles, and old-fashioned politics. *CAUSE/EFFECT* 19 (Fall): 14–21.

Cobb, G. 1993. Reconsidering statistics education:A National Science Foundation conference. *Journal of Statistics Education* 1 (1): 1–26.

Cross,K. P.,and T. A. Angelo. 1988. *Classroom assessment techniques:A handbook for faculty*. Ann Arbor, Mich.: National Center for Research to Improve Postsecondary Teaching and Learning, University of Michigan.

Fair, R. C. 1996. Econometrics and presidential elections. *Journal of Economic Perspectives* 10 (3): 89–102.

Klass, G. M. 1995. Bringing the world into the classroom: POS302-L—the race and ethnicity seminar discussion list. *Ps: Political Science and Society* 28 (4): 723–25.

Light, R. J. 1990. Explorations with students and faculty about teaching, learning, and student life. *The Harvard Assessment Seminars, First Report.* Cambridge, Mass.: Graduate School of Education and Kennedy School of Government.

Meyers, C., and Jones, T. B. 1993. *Promoting active learning: Strategies for the college classroom.* San Francisco, Calif.: Jossey-Bass.

National longitudinal survey of youth (NLSY79), Bureau of Labor Statistics. Available at: HTTP://Stats.BLS.gov/NLSyouth.HTM.

Rossman,A. J. 1996. *Workshop statistics: Discovery with data.* New York: Springer-Verlag.

Snell, J. L., and Finn, J. 1992. A course called "Chance." *Chance: New Directions for Statistics and Computing* 5 (3–4): 12–15.

The Economist. 1997. The Faustian bargain. September. 21–23.

Walvoord, B. E. 1996. *Primary trait assessment: A method for stating criteria and standards in the classroom.* Paper presented at the AAHE Conference on Assessment and Quality, June 1996, Washington, D. C.

Comment

Steve Hurd

The Chizmar and Walbert article presents the authors' experiences using the Web as an active learning medium with undergraduate economics students. The cited examples are structured and evaluated on the basis of a student- and learning-centered educational paradigm, summarized in Chickering and Gamson's "Seven Principles of Good Practice in Undergraduate Education" (1987). The principles are general in nature and, while applicable to economics, they make no specific reference to the current needs of our subject. There is a presumption in favor of what has come to be called active learning and the promotion of effective communication and feedback between students and faculty. Integral to the approach, but again not exclusive to it, is the need to set high expectations and to encourage greater out-of-class study effort, while allowing for different teaching and learning styles.

It is evident from accessing Web addresses cited in the article (save for those with password protection!) that the authors take a broadly eclectic approach toward exploring the capabilities of the Web. Chizmar and Walbert particularly emphasize, however, the use of the Web as a medium for communication and resource management, rather than as a medium for delivering information. As they demonstrate so well, the Web makes available to students, at all hours of the day and night and from both local and distant access points, information about courses: syllabuses, readings, links to useful data sources, and assignment material. Walbert uses the Web as a convenient delivery system for microeconomic spreadsheet templates (although these were not in a form that could be read from within a browser). Some of the more interesting aspects related to the use of bulletin boards, which allow students to publish their answers to tutorial questions. In Chizmar's case, the *Intranet* is used as an extension of the active learning strategies employed in statistics and econometrics classes. Within a problem-centered framework, students use the Web as a data source and medium for reporting their conclusions from statistical enquiries.

Chizmar and Walbert argue that the public nature of the Web can lead to a substantial improvement in students' writing, as well as acting as a focus for out-of-class contact between students. The substantial student written and refereed articles posted in *University Avenue*, an undergraduate journal of economics, were very impressive in this respect. There must surely be doubts, however, about the cost effectiveness of displaying the shorter student responses from the "think-pair-share" activities.

The instructions to students on how to post their replies on the bulletin board ran into several pages, and the activity was clearly time consuming. So, although they could possibly be justified as a one-off introduction on how to use a bulletin board, it would be more cost-effective to take in the replies on paper at the end of a class. One-minute papers, where students record what they do and do not

understand from a particular class, could also probably be done in more cost-effective ways than through a Web-based bulletin board.

A more general point made in the article, in the context of Web-based learning, is that the instructor's role changes from being the information provider to playing a supportive role in learning. This point is a common experience in active and resource-based learning and is not exclusive to Web-based learning.

In Chizmar and Walbert's experiments with the use of the Internet, the Web is always used in a complementary role to the instructor. Their small-scale controlled experiment of distance versus lab-based learning using the same Web-based course materials demonstrates significant gains in test scores for students who have worked in the social setting of the classroom—with additional student-to-student and faculty-to-student support. We generally expect additional inputs to yield extra outputs, and this particular result is encouraging for future instructor employment.

An important aspect of Internet use, which is relatively neglected in this article, concerns the issues involved in using the World Wide Web as a source of data and contextual information to support economic education. The examples chosen tend to emphasize using the Web to reinforce principles and methods classes,and there is relatively little exploration of the capacity of the Internet to enrich the study of economics by providing sources that support the exploration of real-world issues.

Where undergraduate economics courses include student-directed research projects in their assessment programs, the Internet provides opportunities and challenges. Search engines allow students to trawl through distant source material, well beyond the confines of a conventional reading list and probably unknown to their instructors. This has profound implications for our ability to control what is studied under the guise of economics.

In pre-Web days, lecturers considered introduction of students to the authoritative and seminal literature of economics to be an important part of their function. Students used refereed texts supported by focused reading lists. If the system failed, it was when professors failed to update their reading lists or to include pertinent applied material—it is always so much easier to direct students to the standard theoretical literature! The Web opens up a wealth of material, but it introduces its own problems. Computers do not necessarily reduce search time nor increase the availability of quality source material. Much of the material is added by special interest groups, with no refereeing or editing process, so the quality varies enormously. Commercial material from companies tends to be partial. Much freely available statistical material comes without precise descriptors, definitions, or explanatory notes. Material from international agency and government sources tends to be among the most useful for economics, but it is equally partial. Specialist gateways to the Web are being established and they will reduce wasteful search time.

Many lecturers in the United Kingdom are concerned about the growing problems of plagiarism. The Web enables students to gain access to large volumes of text and data that can be all-too-readily copied and pasted into assignment work with little mental processing taking place. This has led some tutors to discourage

the use of Web sources. An alternative, however, is to change the nature of assignments to make cutting and pasting a virtue, and to teach critical use of the Web. For example, an assignment might take the following form:

1. Search the Web and select 3 key questions relevant to a *named current economic issue*.
2. Using different sources, perhaps representing different interest groups, copy and paste statements into your wordprocessor, noting carefully the source of each.
3. Summarize the main arguments in your own words.
4. Critically appraise the arguments in the light of the following readings.

There remains the problem of reading levels. In the United Kingdom, it is increasingly evident that students coming into university have poorer reading skills than hitherto, and more students are finding it difficult to make sense of seminal articles. A copy and pasting mentality does not lend itself to the detailed study of tightly reasoned prose. The Web may make more pages of text available to students, but they still can only read, with understanding, a limited number of words in each study hour. If more hours are spent searching, fewer are available for reading. Consequently the Web might actually reduce genuine study effort. When one couples this with the unrefereed nature of Web materials, it suggests that the prudent strategy might be to plan a modest increase in Web use as part of a well-balanced learning program—as advocated by Chizmar and Walbert.

REFERENCE

Chickering, A. W. and Z. Gamson. 1987. Seven principles for good practice in undergraduate education. *AAHE Bulletin* 39 (7):3–7.

Steve Hurd *is a research fellow, Centre for Economics and Business Education, Staffordshire University, United Kingdom (e-mail:s.j.hurd@cwcom.net).*

Comment

Robert L. Moore

Over 10 years ago, I was cajoled by a colleague into attending an interdisciplinary college teaching conference on collaborative learning, and it almost instantaneously altered my teaching for the better. I got a definite feeling of *déja vu* as I worked through the Chizmar and Walbert article and its accompanying Web sites. These authors illustrate how to enhance—via Web-based learning techniques—many of the active learning tools that a great number of us have come "to know and love." The authors are to be further commended for making

some initial efforts to determine empirically what matters for student learning in these regards, a stark contrast to what appears to be occurring on my own campus where the focus too often is on "technology for technology's sake."

Of course, I have some suggestions for continued improvement in a variety of areas as well as some doubts as to the ultimate probative value of the initial empirical tests of the article. It turns out that my colleagues and I have used most of the active learning techniques here (including computer usage over a local area network, or LAN) but largely without the Web. By comparing what my colleagues and I have learned over the years with what I have observed in this article and the accompanying Web sites, I have gained a greater appreciation of both the advantages as well as the drawbacks of using the Web for improving student learning in terms of Chickering and Gamson's (1987, 1) "seven good teaching principles." I would like to focus most of my remarks on this last comparison.

Strengths

Many of the authors' varied attempts to incorporate Web-based learning into course instruction will evolve and survive as ways to enhance learning. I would include the following as especially promising aspects of the article: (1) the use of the Internet as a way to enhance student-to-student and faculty-to-student interactions. The think-pair-share, one-minute paper, and peer review techniques—all of which we use regularly—are definitely enhanced with the postings on the Web, as are the postings of replies in the econometrics labs. Further, use of the Web reduces the cost to faculty of using these techniques and should therefore increase the likelihood of their adoption; (2) the ability to use the Internet to link students to various data resources on the Web has obvious opportunities in econometrics courses; (3) the potential to increase active learning via such activities as the hypertext labs in econometrics and the Excel workbook in microeconomic theory; and (4) the authors' sensitivity to the need to assess what matters for student learning on the Web.

Weaknesses

Which of the varied Web-based tools genuinely and materially improve the learning process? The on-line course material such as syllabuses and answer keys is a convenience but not a major pedagogical shift. Regarding the workshops in microeconomics, there are many advantages to face-to-face class interactions instead of the PC-based examples noted. Students must often draw curves to learn them rather than just see them manipulated, and pencil and paper and interactive give-and-take with the professor have definite advantages as the way to first approach the material. Second, which of the Web-based techniques will be "too much work" to be worth it for most instructors? For example, Mallard does not appear to be very user friendly for instructors authoring their own content. Third, and perhaps most important, how well does the active learning approach here accommodate differing learning styles? It seems that *all* students must learn within the Web context as a starting point. Using technology as an

extra tool instead of the common backdrop may better address learning style differences.

Every faculty member I spoke to was extremely interested in the empirical test summarized in footnote 8, namely whether on-line learning accompanied by face-to-face interactions (both student-to-student and faculty-to-student) was superior to on-line learning without these interactions. The initial results were encouraging for those like myself who espouse the virtues of a residential, liberal arts college education. I would recommend extending the results to control for other factors via the standard educational production-function approach. In addition, I would suggest using Heckman's two-step procedure to correct for self-selection over the course of study resulting from student attrition.

Further Observations and Suggestions

In my department, we have tried a wide variety of teaching techniques along the lines covered in this article, including on-line syllabuses and course material, on-line interactive PC workbooks in microeconomic theory on a LAN (without the Web), a collaborative learning lab (where students, working in groups of three or four outside of regular class hours, take additional short quizzes by orally and randomly explaining their group's answers to a junior or senior student mentor), peer review of major papers, and an active learning approach (similar to the econometrics labs here) that we refer to as a "paper blizzard" because of the daily hard copy handouts containing brief lecture notes, numerical exercises for students to complete during class, spaces for students to draw new curves based on extended class applications, and review exercises.

What have we learned and what suggestions can we offer? First, active learning is the way to go, but much of it often works as well (or better) in low-tech forms: face-to-face collaborative problem solving, paper and pencil via the paper blizzard. Second, a variety of approaches is beneficial; avoiding too much of any one approach, including technology, seems to work best for both student learning and student interest/enjoyment. Learning styles do differ, including the usefulness of computer applications and workshops. Third, the Web still lags LAN for some of the most extensive computer *interactive* work we do. Our homegrown computer program provides students with question-by-question grading and clues; our computer labs not only involve interactive progression of diagrams (vs. the fairly static approach on the Excel workbook) but also require students to respond to queries via pencil and paper before hitting the Solve button.

I offer these suggestions for the authors' consideration as well as encouraging them to extend their empirical assessment of what matters for student learning.

REFERENCE

Chickering, A. W., and Z. Gamson. 1987. Seven principles for good practice in undergraduate education. *AAHE Bulletin* 39 (7):3–7.

Robert L. Moore *is a professor of economics at Occidental College (e-mail: moore@oxy.edu).* *He thanks his colleague, Jim Whitney, for productive discussions about many of the teaching issues here.*