Internet Usage in Agricultural Economics Instruction

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Abstract

According to the popular press, the Internet has fostered a revolution in educational technology. This paper examines the extent of the revolution in agricultural economics instruction. A web crawler is used to locate and categorize online course materials. Forty-five percent of the agricultural economics courses sampled had a website but only 23 percent of the courses sampled used a website to convey course content. Most of the materials found are traditional course documents transmitted over the Internet. These materials substitute directly for "traditional" teaching materials. Economic production analysis indicates that if a new input directly substitutes for an existing input, and if the new and existing inputs cost roughly the same and are a small portion of the total cost of the output, then output will be largely unaffected by the choice of the new versus the old input. By this argument, current online agricultural economics course materials will not greatly increase learning. Internet applications that offer promise are those that do not directly substitute for existing materials or those that significantly reduce the student's cost of learning a concept. These applications were not found. Hence, the educational revolution has had limited impact in agricultural economics.

Introduction

The popular press subscribes to the notion that a revolution in educational technology is well underway. The roots of this revolution are discussed in a 1995 Wall Street Journal report that cites the potential for new technologies such as multimedia, local area networks, and the Internet to revolutionize education in all arenas including K-12, colleges and universities, and corporate training (Bulkeley, 1995). The reported benefits offered by these technologies include improved retention, reduced boredom, and lower costs of education. Also cited are less tangible benefits that include higher student achievement, improved attitudes and self-esteem, and enhanced quality of student-teacher relationships. On March 12, 2001, The Wall Street Journal featured a special section devoted to e-education. The section caption reads, "The Web is transforming education - what we learn, how we learn, where we learn." One featured article reported on the success of online instruction at the University of Minnesota, Crookston, a campus that has specialized in technology-integrated courses (Ramstad, 2001). A second featured article reports on instructional technology's unfulfilled expectations suggesting “online classes can be tough to find, hard to sign up for - and a bore once you get there.” (Hamilton, 2001).

This paper investigates the state of online instruction in agricultural economics. Because agricultural economists have a tradition of instructional computing, it seems plausible that the Internet would be used in innovative ways. Also, some agricultural economics departments offer distance education for specific curricula, so it seems plausible that the techniques used in these curricula might be applied to on-campus courses. Alternatively, the use of the Internet in agricultural economics instruction may not be widespread because new teaching techniques are slowly adopted in economics. In reporting on a national survey on teaching undergraduate economics, Becker (1997, p. 1348) states, "In contrast with other disciplines that have moved to a broad teaching repertoire, economics continues to be taught by the lecture method in all undergraduate courses." A similar conclusion is reported in Becker and Watts (1996) that " ... as a group, college economics teachers rarely use innovative teaching techniques." These findings are especially surprising in light of an economics instruction literature survey that finds the effective use of various teaching techniques including (a) classroom games, simulations and laboratories, (b) economic experiments, (c) writing assignments, (d) assignments based on economics in literature and drama, (e) analysis of the Nobel lectures, (f) analyses of popular and business press readings, (g) case studies, and (h) cooperative learning exercises (Becker and Watts, 1995). Beneficial economic-instruction Internet applications have also been reported (Vachris, 1999; Agarwal and Day, 1998).

The objective of this paper is to determine the extent and methods of Internet use in agricultural

economics instruction. More specifically, we seek to address three questions: (1) How is the Internet being used? (2) How much is it being used? and (3) What are the likely learning outcomes? Determining how the Internet is being used and the extent of this utilization will allow us to identify potential benefits. We will also discuss Internet applications that are not widely adopted in agricultural economics instruction and discuss the potential benefits of these applications.

Table 1. Departments Offering Agricultural and Resource Economics Courses.

University Type	Number	Department Type: Ag Econ	Econ	Agri-business	Agriculture	Other
U.S. Land Grant	53	48	4	0	0	1
U.S. 1890	13	1	0	1	11	0
U.S. Other	31	3	3	9	13	3
Canadian	7	6	1	0	0	0
Totals	104	58	8	10	24	7
Western U.S. Land Grant	20	17	2	0	0	1

Table 2. Departments Surveyed for Agricultural and Resource Economics Course Websites.

University	Department
Univ. of Alaska	Agricultural and Land Resource Management
Univ. of Arizona	Agricultural and Resource Economics
Univ. of California, Davis	Agricultural and Resource Economics
Univ. of California, Berkeley	Agricultural and Resource Economics
Colorado State Univ.	Agricultural and Resource Economics
Univ. of Hawaii, Manoa	Agricultural and Resource Economics
Univ. of Idaho	Agricultural Economics and Rural Sociology
Kansas State Univ.	Agricultural Economics
Montana State Univ.	Agricultural Economics and Economics
North Dakota State Univ.	Agricultural Economics
Univ. of Nebraska, Lincoln	Agricultural Economics
New Mexico State Univ.	Agricultural Economics and Agribusiness
Univ. of Nevada, Reno	Applied Economics and Statistics
Oklahoma State Univ.	Agricultural Economics
Oregon State Univ.	Agricultural and Resource Economics
South Dakota State Univ.	Business Economics
Texas A&M Univ.	Agricultural Economics
Utah State Univ.	Economics
Washington State Univ.	Agricultural Economics
Univ. of Wyoming	Agricultural and Applied Economics

Methods

This section addresses the first two questions: How is the Internet being used in agricultural economics instruction? And what is the extent of Internet usage in agricultural economics instruction? These questions are considered together because both are addressed with a survey methodology. The first question has a qualitative dimension. Its answer requires determination of the type of material communicated via the Internet, the intended use of the material, and how the intended use relates to the use of similar traditional instructional materials. The second question has a quantitative dimension. Its answer will be couched in terms of the Internet's "market share." The data required to answer these questions can be gathered by finding agricultural economics course websites and then recording the quantity and characteristics of the materials contained therein. This process was automated by using a web crawler. Many web crawling programs are freely available on the Internet (www.robotstxt.org/wc/robots.html) and the Thomas (1997) web crawler was used.

Agricultural economics course offerings were located through the American Agricultural Economics Association (AAEA) 2000-2001 membership directory, which lists 104 departments, divisions, schools, and colleges that conduct agricultural economics instruction in the United States (97 units) and Canada (7 units). These instructional units are located in Land Grant, 1890, non-Land Grant, and Canadian universities. Based on department titles and course offerings, departments were classified as agricultural economics, economics, agribusiness, general agriculture, and other (Table 1). Though departments are diverse, Land Grant university departments are more homogeneous than other departments.

Instructional unit websites were found through parent university websites (obtained from www.google.com). Each unit's course offerings (course numbers, titles, and descriptions) were compiled from its parent university's online catalog. This survey, conducted in late May of 2001, revealed that the instructional units teach well over 2,000 courses, each with a potential website. To reduce the scale of the search for course websites, the population was narrowed to include only on-campus undergraduate courses in agricultural and resource economics. Special topics, internship, senior seminar, and independent study courses were also excluded. Programming the search for course websites and analyzing their content was still not possible within the allotted time for the project. Therefore, the twenty Western U.S. Land Grant University agricultural and resource economics departments served as a manageable sample for program development and

testing (Table 2). These departments are representative of U.S. Land Grant departments (Table 1) and are in the same region as the author's home department offering some familiarity with courses and curricula.

These departments taught 376 undergraduate agricultural economics courses. Websites were sought as follows. If course websites were listed on a departmental or university website, then the associated addresses were used. Otherwise, departmental faculty profiles were searched for links to websites for courses taught. This information was gathered in June of 2001.

Course website content was inaccessible at North Dakota State University and New Mexico State University because of password protection and no course websites were found for the University of Hawaii, either because they didn't exist or because the search method failed. Consequently, the courses from these three departments were excluded from share computations. The remaining departments offer 293 courses for which 133 websites were found. Thus, one measure of Internet usage in agricultural economics instruction is that 45 percent (133/293) of the courses surveyed had a website.

The web crawler scanned the 133 course websites during early July of 2001 and recorded for each page in each website, the page title and address, the hyperlink path to the page, and the text and address for each hyperlink in the page. The recorded information was verified by manually browsing the site. The materials found are summarized in table 3. The left-most column classifies the instructional material based on the text in the hyperlinks leading to the material. The second and third columns respectively indicate the number of websites and the number of documents containing each type of material. The remaining columns indicate counts of document types based on file-name extensions.

Table 3 shows that the most common materials in agricultural economics course websites are email links to the instructor and course syllabi as 54 percent (72 of 133) and 53 percent (71 of 133) of the websites contain these respective elements. The number of online syllabi (84) exceeds the number of courses with an online syllabus (71) because some courses offer a syllabus in html, pdf, and word processor (doc) formats.

While 45 percent of the surveyed courses had a website, closer inspection reveals that many websites do not convey subject matter. More specifically, 64 of the websites contained nothing more than a syllabus, a course calendar, a course outline, and email link(s) to the instructor(s). By this measure, 23 percent [(133-64)/293] of the courses surveyed use the Internet to convey subject matter.

Table 3. Summary of Materials Found on Agricultural and Resource Economics Course Websites.

Material	# of sites[z]	# of links	Material type (indicated by file extension) html	pdf	ppt	xls, wks	doc	Other (type)
Email instructor	72	89	3	0	0	0	0	86 (mailto)
Syllabus	71	84	56	22	0	0	6	0
Homework assignments	34	188	43	76	10	49	10	0
Past exams	33	152	33	92	0	6	21	0
Lecture notes	27[y]	508	108	273	113	10	4	0
Related links[x]	21	150	146	2	0	0	0	2 (asp/cgi)
Course outline	17	20	16	3	0	0	1	0
Readings	12	110	60	45	0	0	1	4 (asp/cgi)
Course calendar	10	13	10	2	0	0	1	0
Homework solutions	8	40	3	34	0	2	1	0
Course grades	8	11	4	3	0	2	0	2 (asp/cgi)
Course announcements	6	17	7	10	0	0	0	0
References	4	41	39	1	0	0	1	0
Course software[w]	4	7	7	0	0	0	0	0
Data sources	4	6	6	0	0	0	0	0
Discussion/listserv[v]	4	4	4	0	0	0	0	0
Classmate identity	3	7	7	0	0	0	0	0
Web search	3	4	4	0	0	0	0	0
Instructor contact info	3	5	5	0	0	0	0	0
Entertain/amuse	2	7	7	0	0	0	0	0
Tutorials	2	7	6	1	0	0	0	0
Textbook information	2	3	3	0	0	0	0	0
FAQ	2	2	2	0	0	0	0	0
News services	1	8	4	0	0	0	0	4 (asp/cgi)
Instructions	1	5	5	0	0	0	0	0
Illustrations	1	2	0	0	0	0	0	2 (jpg/gif)
Audiovisual	1	1	0	0	0	0	0	1 (avi)
Course evaluation	1	1	1	0	0	0	0	0
Glossary	1	1	0	0	0	0	1	0
Student survey form	1	1	1	0	0	0	0	0
Totals		2182	1083	587	123	69	47	89

z/ 133 course websites examined.
y/ Lecture notes were password protected for two courses. Document counts do not include these courses.
x/ Variously indicated as other links, useful links, valuable links, and related links.
w/ Includes links to gams, shazam, limdep, and computer simulations.
v/ Includes catalog of past email responses.

Table 3 also shows that most of the online materials are static documents that correspond to traditional class handouts. For example, homework assignments and past examinations stored as Microsoft Word (*.doc), pdf (*.pdf), or HTML (*.htm or *.html) files with no embedded links or scripts do not create student interaction. These files will either be printed for later perusal, or viewed on a monitor. As a counter example, Common Gateway Interface (*.cgi) or Active Server Page (*.asp) files can be used to elicit student interaction with the website and to provide the student with immediate feedback. This interactivity differentiates ASP and CGI documents from traditional class handouts. The absence of interactive documents and the abundance of static documents indicate that currently students use online homework assignments and past examinations as if they were handouts.

This observation also applies to online lecture notes, the classification with the most files (table 3). Many students will print these notes from either word processor or pdf files. Lecture notes in PowerPoint (*.ppt) and HTML files frequently correspond and have parallel hyperlinks. They have few embedded hyperlinks and no links to multimedia elements. This indicates that instructors use PowerPoint slides in lecture, save the PowerPoint files in HTML format, and offer students the slides online in a choice of formats. The use of these online materials is equivalent to the materials resulting from the traditional practice of reproducing and distributing the class overheads and lecture outlines.

Online readings for some courses are password protected (indicated by four asp/cgi files, Table 3) so the documents beyond the password gateway could not be analyzed. However, the class readings that could be analyzed are offered either as pdf or HTML documents. The online readings will likely be printed to replace readings delivered by traditional methods.

Table 3 shows many other types of materials on agricultural economics course websites. A few applications capitalize on the Internet's computational and informational processing capabilities in ways other than document transmission. Examples include links to course-related Internet materials (not "my favorite sites"), grade reports through links to the university registrar, spreadsheets used for online examples, and threaded discussion managers. However, most applications are designed to simply deliver printed documents over the Internet.

Results

The most important finding from our survey is that most of the online materials are textual documents that correspond to or replace traditional class handouts. Grimes, Sanderson, and Ching (1997, p. 79) report "the computer was not found to be a popular elective study tool with students in a typical Principles of Economics course." Partridge and Osborn (1999) discuss "print and go" behavior, the tendency for students to print online course materials for later reference. According to these studies students are likely to print, for later perusal, documents deemed to be important.

If students practice "print and go" with the online documents, then the use of these materials is little different from traditional class handouts or packets of class notes. If students instead elect to read documents on the computer monitor, then the online materials are the virtual equivalent of traditional handouts. Whether documents are read from paper or a monitor is of minor importance because in either case, the online materials readily substitute for traditional class handouts. Thus, course websites provide a "new" teaching input that readily substitutes for a "traditional" teaching input.

The economic analysis of technological change handily accommodates substitution between "new" and "traditional" inputs. The learning curve, representing the relationship between time spent on an activity and the resulting learning, is a production function to economists. More general production functions represent the relationship between learning achieved with various combinations of new and traditional inputs. The economic approach assumes that the student allocates study time so as to maximize the net value of learning (Dahlgran, 1990). The impact of online course materials is evaluated by comparing learning achieved under the traditional technology (class handouts) to learning achieved under the new technology (Internet-delivered course documents). The near-identical nature of Internet-delivered and handout-delivered documents means that an additional hour spent studying either one creates the same additional learning. Consequently, the optimized value of learning is unaffected by offering Internet-delivered documents instead of, or in addition to, handout-delivered documents.

This conclusion can be better understood by considering a logically equivalent problem of a river-town bakery. Suppose that the bakery can use flour milled from wheat produced either west or east of the river and that the two types of flour are identical and cost the same. The flours are perfect substitutes so the baker will use the same quantity of flour, produce the same quantity of bread, and earn the same profit regardless of the flour's source. The baker could even combine the flours and his production level and profitability would be unaltered. The student's time is analogous to the baker's flour. An hour devoted to studying handouts duplicated and distributed by the instructor is as productive as, and has the same opportunity cost as, an hour devoted to studying the same material obtained from the course website. Like the baker, the student will devote the same amount of time to the course, and learn the same amount, regardless of the handout's source.

Availability differences between Internet-delivered and handout-delivered materials might seem to weaken this conclusion, as Internet-delivered materials are practically always available whereas handout-delivered materials may not be available during evenings, weekends, and holidays. However, the "print and go" model of online document procurement means that access to course documents is an issue only once for Internet-delivered materials, the same as for handout-delivered documents. The Internet's availability advantage is reduced accordingly. Also diluting the Internet's advantage is the instruction that frequently accompanies students' procurement of in-class handouts but is frequently missing with online document procurement.

Summary

The majority of the materials found on agricultural economics course websites substitute directly for traditional handouts. Because acquisition costs for both online and traditional documents are small, and because online documents substitute directly for traditional class handouts, the learning enhancements attributable to these materials will be small. Course websites are nonetheless beneficial because they increase the availability of course materials. As discussed above, the learning outcome differences will be minor.

The limited learning enhancement potential for most existing agricultural economics course website materials is not due to the Internet but due to the near perfect substitutability of Internet-delivered materials for traditional course materials. The Internet still has the largely unexploited capability to provide course materials that are fundamentally different from traditional teaching materials. For example, materials that foster either instructor-student or student-student interaction are not perfect substitutes for traditional teaching materials but these materials are relatively scarce. Specific examples of interactive technologies include active server pages (ASP), common gateway interfaces (CGI), and web page scripts. These technologies elicit a student response before response-dependent results are communicated back to the student. Other technologies, such as threaded discussion managers generate interaction among students. The difficulty of implementing these applications explains their scarcity, but they offer substantial benefits by taking the student from a passive to an active learning mode. Teaching innovations that involve students as active instead of passive learners are the most productive. (Simkins, 1999, p. 286, citing conclusions by Bartlett, 1996; Becker and Watts, 1996; Becker, 1997; Bonwell, 1992; Cameron, 1998; Claxton and Murrell, 1987; Johnson et al., 1991; and Meyers and Jones, 1993).

Finally, course websites can offer instructional media that cannot be offered economically in a traditional format. Examples include simulations, audio, video, graphical, and visual materials. The enhancement of these materials makes them more productive than the traditional materials. For example, a movie is more illustrative than a sequence of static drawings and a simulation is more illustrative than a detailed analysis of outcomes under different conditions. The greater productivity and lack of perfect substitutability for the traditional teaching material gives these materials the potential to substantially enhance learning. Other computational technologies, such as website searching and indexing, though not found with our search, allow students to more directly target sought-after information thereby increasing the productivity of the student's time spent learning.

In failing to find high-end website applications, this study finds discrepancy between the optimistic case for online education described in the Wall Street Journal and current practices in agricultural economics. Web-based course offerings are rather limited with about 23 percent of all regularly scheduled undergraduate agricultural economics courses utilizing a website to convey instructional materials. This suggests a number of possibilities. The first is that agricultural economics is behind other disciplines in developing Internet-based instruction. This may be either because agricultural and resource economics subject matter is not amenable to Internet enhancement or because the rewards for implementing this technology are insufficient to compensate the instructor for other uses of his/her time. In either case, instructors have personally assessed the perceived costs and the benefits of Internet implementation and have made rational choices. Another possibility is that the popular press, in reporting anecdotal evidence, has exaggerated the state of online instruction at colleges and universities.

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