Economics

A Discriminant Analysis of Students' Perceptions of Web-Based Learning

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Students enrolled in undergraduate economic statistics classes at Youngstown State University (YSU) were surveyed in an attempt to differentiate between users and nonusers of Web-based instruction (WBI) as a supplement to the traditional classroom lecture/problem-solving approach. Discriminant analysis and descriptive statistics tools were used to compare and contrast the perceptions of users and nonusers. The users concluded that distance learning via the World Wide Web (WWW or the Web) was not only a good method of obtaining general information but a useful tool in improving their academic performance in a quantitative economic class. Nonusers thought the university should help provide financial assistance for going online and that WBI should not be required for graduation.

Keywords: Web-based instruction, Internet, information technology, discriminant analysis

The advent of the Internet and related information technology (IT) is a major development of the waning years of this century that will ever change the way knowledge is imparted to the widest audience inside and outside the classroom. Institutions of higher learning worldwide are rushing to install or upgrade the necessary telecommunications infrastructure in order to promote Web-based distance learning (WBDL). Although WBDL (or electronic distance learning) is not a substitute for the traditional classroom lectures and related protocols, it is a powerful supplement that is gaining acceptance worldwide in academia.

An important aspect of teaching is to continually search for efficient methods of delivering knowledge to students. Using innovative techniques to improve student learning (skills) is important in education, especially in teaching quantitative economic classes such as econometrics and statistics. Unfortunately, many students find these types of classes difficult because they involve some mathematics, statistics, and computer applications, and require some knowledge of the bodies of economic theories. The Internet is a powerful, flexible, and efficient tool for delivering instructional materials to students taking such classes. "It provides new ways for us to teach and learn. It allows us to do new things, as well as do traditional things in new ways" (Burgstahler, 1997, p. 63). Furthermore, the cyberspace of the Internet's World Wide Web (WWW or Web) is emerging as the easiest and most popular medium for delivering instruction (Kahle, 1997; McManus, 1995).

Distance learning is a term that is used in a variety of ways. Generally, it is a new structure for education that covers the broad range of teaching and learning events in which the student

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is separated (at a distance) from the instructor or other fellow learners (Hoyle, 1997). This article will examine issues relating to student receptiveness/resistance to the use of the Internet, specifically the Web medium, as a tool of distance teaching/learning (commonly referred to as distance education) in a regular university setting where lectures and handouts have historically been the primary avenue to deliver course content. Because instructional materials are also delivered via the WWW in conjunction with the traditional classroom lectures/handouts, we refer to this form of distance education as Web-assisted distance education (or simply Web-assisted education) and the instructional format as Web-based instruction (WBI). Web-assisted education should not be confused with distance education; these are overlapping, not nested, terms. The latter term refers to a teaching/learning situation in an open university.[1]

During the 1996-1997 academic year at Youngstown State University (YSU), students enrolled in quantitative or statistics classes offered by the economics department had the opportunity to use the Internet and a Web site developed by the economics department (Usip, 1997). The purpose of developing the Web site was to make the subject matter more palatable and the learning process more enjoyable for students by bringing instructional materials to them any time irrespective of their geographical location. One would hope that since students had the opportunity to use the Internet, and the economics Web site in particular, this might help to minimize the phobia for quantitative-type classes.[2] Although students were encouraged to take advantage of the distance learning technology, participation was voluntary. Given that the instructional materials on the Web were made available and their possible use had been advocated, the issue remained as to who would actually use the Internet technology for electronic distance learning/teaching, since participation by both students and faculty was voluntary.

The focus of this research is to develop profiles of student users and nonusers of WBI materials and to compare and contrast their perceptions on various issues dealing with the use of the Internet technologies. Specifically, we will attempt to differentiate between the attitudes of users and nonusers on issues pertaining to electronic distance learning for students taking a quantitative economics course. How do the perceptions of individuals in these two groups differ with special emphasis on the nature and extent of use by the Internet users and the reasons why other individuals are not participants in this technological revolution? The findings will contribute to the understanding of factors that influence the adoption of new computer-based technologies.

COMPUTER-BASED LEARNING TECHNOLOGIES: STUDENT RESISTANCE ISSUES

With the rapid advancements in telecommunications technology (and the Internet in particular) in recent years, a great deal of interest has developed about Web-assisted education and its use in different disciplines (Murphy & Terry, 1997). The ability of the WWW and the Web browsers to integrate graphics, text, and sound into a simple tool means that novice users do not have to struggle with such a steep learning curve. Because changes in the way knowledge/information is disseminated to the widest audience can have significant societal impact (Cornman, 1996), prudence suggests that efforts be made to assess actual and potential effects of the emerging information technology. Moreover, it is imperative that an individual be able to surf the Internet if he or she wishes to be on the cutting edge of technological advance.

Although much has been said and written about the potential of the Internet as a powerful tool in education, there is some evidence of resistance to the use of computer-based learning

technologies in general. Resistance can come from college/K-12 administrators (for costs and equity reasons; Garson, 1996), faculty (Gunawardena, 1990; Porter & Riley, 1996), and students. Empirical evidence on the reluctance of students to use Internet technologies for WBI in the regular classroom is relatively scarce. Because WBDL uses individualized computer-based learning technologies, conclusions from existing studies of factors that lead to student (and faculty) resistance to other computer-aided learning technologies serve as the analytical premise for this study. Our analysis is consistent with the following areas of possible resistance that have been identified in the existing literature: (a) time costs of using a new learning technology, (b) financial costs of equipment and peripherals necessary for using a new learning technology, (c) perceived values or benefits of using a new learning technology, and (d) background experience in the use of new equipment and peripherals involved in using a new learning technology.

We will frame our discussion around similar issues. The first issue is student time costs of using the Internet technologies for WBDL. This was a critical issue of concern when developing/deploying the economic Web site because "nontraditional teaching techniques are often avoided because they require additional time commitments by faculty and students" (Porter & Riley, 1996, p. 291). In addition, if the specific technique involves computer application, students in the social sciences tend to fear that the computer will take so much time to learn and operate that they will not be able to do their work (Bowers & Bowers, 1996). Our results will show that nonusers expressed a similar phobia. The second issue is students' monetary/financial costs of going online. Internet access entails the costs of a computer and related peripherals such as a modem, and the dial-up costs when access originates from the student's home or workplace. The limitation of using the Internet/IT as an educational tool is that equal access to all students may not be guaranteed due to financial and technical barriers (Burgstahler, 1997; Garson, 1996). This is a serious equity issue, especially in commuter institutions that require students to do most of their individual learning at home. The problem associated with Web-assisted education should be a matter of concern to the academic administrators. In this study, nonusers expressed the sentiment that the university should help to defray the costs of going online. The third issue is student-perceived values of WBI as a supplement to in-class lectures and problem solving. Students who elect to use a new learning technique tend to exhibit some expectation about its potential benefits, such as a higher GPA. For example, in a study by Porter and Riley (1996), economics students who were taught with computer-assisted instruction (CAI) indicated at the end of the experiment that the use of CAI in introductory statistics contributed to their high GPA. In this study, only the users felt that the integration of WBI would enhance their GPA. The fourth issue is student lack of prior or home exposure in the use of the computer and the Internet/IT. It has been found in other individualized computer-based learning applications that the more experience a student has had with a computer, the more likely it is that he or she will have a low level of anxiety (Chu & Spires, 1991), and therefore the more likely it is that he or she will be receptive to the use of new computer-based technologies. Conversely, a student is likely to feel intimidated if he or she comes from a family that does not own a PC (Campbell, 1986), and therefore would be more likely to resist the use of new technologies that involve the use of the computer. In this study, the majority of the users said that they acquired both the computer and Internet skills at home.

METHODOLOGY

Students enrolled at YSU during the 1996-1997 school year are the focus of this research design. YSU, with an enrollment of approximately 12,000 students, is a state-supported

institution of higher learning in northeast Ohio. The student population is somewhat unique in that the university is primarily a commuter-oriented school with a small percentage of students actually residing on campus. A second aspect of the student population is that many students are employed on a full- or part-time basis while taking classes; thus, they spend a minimum amount of time actually on campus.

Students taking an introductory statistics course offered by the economics department were the target population for the study. The use of the computer for data analysis is mandatory in these classes, and the actual hands-on experience with the SPSS/win is accomplished in several computer labs on campus. Computers in these labs are harnessed to both the local YSU network (where the SPSS/win program is installed) and the Internet via Unix host servers. Thus, students in these classes have access to the Internet from the labs while on campus and from off-campus locations classes by dialing up the Unix servers through the point-to-point (PPP) connection. Even if individuals were not users of the Internet, they were encouraged to complete the questionnaire if they had at least some idea of the Internet revolution and the economics Web site, and the associated benefits and costs of each.

Data were collected by means of a structured questionnaire developed by the authors. The instrument was reviewed by faculty involved in the Master Teaching Program at the university and those involved in attitudinal measurement research. The questionnaire was designed to achieve two objectives. One section of the questionnaire was designed to establish profiles of users and nonusers of the Internet as a tool of distance learning. It was deemed important to determine from the viewpoint of the users issues such as how often do they use the Internet for entertainment, academic pursuits, and general information and who is responsible for introducing them to the Internet? Likewise for the nonusers, the objective in the demographic profile was to determine why they had opted not to be participants in the technology.

The second part of the questionnaire contained 17 issues dealing specifically with various aspects of electronic distance learning as students were taking a quantitative course. Using a 5-point Likert-type scale ranging from *strongly agree* (1) to *strongly disagree* (5), respondents were asked to provide their opinions on a variety of issues such as the likelihood distance learning would have a positive impact on their academic performance in a quantitative-type course, the adequacy of facilities/personnel, and whether a course in distance learning should be required for graduation from the university. Table 1 provides a brief summary of the attitudinal statements used on the questionnaire.

The data analysis will include both descriptive measures and statistical inference techniques. Initially, measures of central tendency (mean, median, mode) and dispersion (standard deviation) will be computed for the attitudinal variables. The second phase specifies the discriminant model for the purpose of classifying individuals into one of the two groups on the basis of their attitudes/opinions toward the use of the Internet technology. The final phase validates the predictive efficiency of the estimated model for future use in predicting whether a student in a statistics class that uses WBI to supplement classroom lectures is more or less likely to use the Web resources through distance learning.

The Fisher (1936) discriminant function has the form

$$Z = \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_k X_{ik}, \tag{1}$$

where each X_{ij} represents the attitudinal variable j ($j = 1, 2, \ldots, K$) of an individual i and b_j are the discriminant coefficients. The discrimination is to be carried out between the two mutually exclusive groups: Internet users and nonusers. Denoting the two mean values of Z

TABLE 1
Attitudinal Statements Included on Questionnaire

Variable Number	*Description of Variable*
1	A valuable tool for improving grade in a quantitative course
2	A valuable tool for obtaining general information and facts
3	I recommend others to become active participants with the Internet
4	A valuable supplement to class lectures
5	A valuable tool for collecting data for research projects
6	Benefits received far exceed associated costs
7	The e-mail facility is an effective way of communicating with faculty and other students
8	Technology is a necessary prerequisite for future education
9	By using the Internet, my cumulative grade point average will be higher
10	The university provides adequate Internet facilities
11	The university provides adequate personnel to offer assistance in how to use the Internet
12	The university should provide financial assistance in form of low interest loans so students can afford the expenses associated with using the Internet
13	Is a good method to offer some types of courses
14	It is important that instructors respond by e-mail to course-related questions
15	Prefer a course in which the Internet was used extensively rather than a course in which it was not used at all
16	I believe a course in which the Internet technology is used should be required for graduation from the university
17	It is easy to ask and receive answers to my questions using the Internet medium

by $\bar{Z}_1$ and $\bar{Z}_2$ and the pooled sample variance as S_z^2 (this statistic is similar to the one used in the standard two-sample t-test), the squared distance D^2 between the means of the standardized value of Z is computed as

$$D^2 = \frac{(\bar{Z}_1 - \bar{Z}_2)}{S_2^2}$$

to measure how far apart the two groups are from each other in terms of the values of Z. The goal of Fisher's linear discriminant analysis is to select the coefficients $\beta_1, \beta_2, \ldots, \beta_k$ so that D^2 (otherwise called Mahanalobis distance) has the maximum possible value. This procedure is implemented in the SPSS for Windows (SPSS/win) statistical package, which is used to estimate the model in equation (1). More theoretical details and applications of the discriminant analysis techniques can be found in Afifi and Clark (1984) and Johnson and Wichern (1988).

RESULTS

Initially, respondents were classified as either being a user or a nonuser of the Internet technology. No attempt was made to control for the percentage of respondents who were in either group. The final sample size of 153 included 78 (51%) who were users and 75 (49%) who were nonusers.

The first stage of the data analysis was to construct a profile of the users of the WBI materials. Table 2 provides data on the percentage of respondents classified by where they were first introduced to the WWW. Clearly, the home and university were likely to be the first environments in which an individual first became acclimated to the Internet. An obvious

TABLE 2
Where First Introduced to the Internet

Location	*Percentage of Respondents*
Home	41.8
Job	9.1
University	40.0
Other (friend)	9.1

implication of this result is that many students in a class that combines WBI with the traditional lectures/handouts bring to class their prior knowledge of the key tool of computer-based individualized learning (in this case the Internet/IT). This is in stark contrast to other computer-aided methods of teaching such as CAI, in which students are likely to be exposed to a specific instructional software (as the learning tool) for the first time at school when they enroll in the class.[3] Then, students must spend time to learn how to use the software before being able to actually master the instructional materials. For some programs, the learning curve can be quite steep for both the learner and the instructor (Porter & Riley, 1996). Moreover, the skills acquired by using a specific instructional software in one discipline or subject area are usually not transferable to other disciplines and subject areas. Internet skills, whether acquired at home or school, *are* transferable.

The next component of the profile was to determine who was personally responsible for introducing the user to the Internet. Table 3 provides summary results for this demographic characteristic. It appears that the individual personally, a university professor, or friend were the people most likely to provide the personal incentive for the individual to use the Internet. Again, the implication of this result is that for users of WBI, a significant level of motivation in the use of the Internet technology as a learning tool originates from home, self, and friends (67.3%) and not from the instructor. The benefit is enormous considering the time that is saved by both the student user (who already knows how to use the Web medium) and the instructor (who may use the extra time to develop more instructional materials rather than teach how to use the medium).

A third consideration in constructing the profile for the consumers of Web-assisted education was to determine the nature and extent of use of Internet technology. Table 4 summarizes descriptive statistics for the three categories of use per week: entertainment, academic, and WBI and general information gathering. In summary, the typical response was that about one hour per week was spent in each of the three areas of possible use. For each functional area of possible use, the value of 1 was assigned to less than 1 hour, 2 to 15 hours, and so on. It can thus be surmised that prior exposure to the Internet at home for entertainment and general information is the main reason why the users bring some degree of motivation to the consumption of WBI.

To better understand the nonusers, respondents were asked why they did not avail themselves of the Internet technology for information/instruction delivery (see Table 5). The modal response (35%) indicated that nonusers simply did not have the time to learn how to use the Internet. An equal percentage of respondents (17%) indicated they did not have a personal computer, or believed the associated expenses of buying a computer, modem, and online services were too high. It should also be noted that 14% indicated they had no desire to learn how to use the Internet. In summary, whereas approximately half of the respondents indicated that they had neither the time nor desire to use the Internet, the reasons for nonuse expressed by the remainder of nonusers can possibly be addressed by the university

TABLE 3
Person Responsible for Introduction to the Use of the Internet

Person Introducing	*Percentage of Respondents*
Family member	18.2
Friend	21.8
Coworker	5.5
Professor	25.5
Yourself	27.3
Other	1.8

TABLE 4
Nature and Extent of Internet Use

Functional Area of Use per Week	*Percentage of Respondents*	*Mean*	*Median*	*Mode*	*Standard Deviation*
Entertainment		1.673	2.00	1.00	.795
Less than I hour	49.1				
1-5 hours	38.2				
6-10 hours	9.1				
10 or more hours	3.6				
Academic		1.564	2.00	1.00	.601
Less than I hour	49.1				
1-5 hours	45.5				
6-10 hours	5.5				
10 or more hours	—				
General Information		1.527	1.00	1.00	.573
Less than I hour	50.9				
1-5 hours	45.5				
6-10 hours	3.6				
10 or more hours	—				

administration and faculty in such a way as to encourage use. Specific suggestions are provided in the concluding section of this article.

Survey respondents, users and nonusers, were asked to respond to 17 attitudinal questions using a Likert-type scale ranging from *strongly agree* (1) to *strongly disagree* (5). Table 6 provides means and standard deviations for the two groups; Figure 1 provides a graphic presentation of the rank order of perceptions by the students. By the nature of the scaling procedure, the lower the average score, the more the respondents tended to agree with the statement; conversely, the higher the mean score, the more respondents disagreed with the particular issue. The user group rated seven variables (2, 3, 5, 6, 7, 8, and 13) below an average score of 2.0, indicating various degrees of agreement. The nonuser group rated only four variables (5, 7, 12, and 14) below 2.0. Each of the two groups had average scores below 2.0 for variables 5 and 7. The users tended to strongly agree that electronic distance learning through the Web medium was a good method of obtaining general information (V2), a necessary prerequisite for future learning (V8), a valuable means of collecting data (V5) and efficient because the benefits exceeded the associated costs (V6). The users also agreed that e-mail provided an effective means of communication with faculty and other students, that the Internet was a tool they would recommend to others (V3), and that the Internet was

TABLE 5
Reasons for Not Using Internet Technology

Reason	*Percentage of Respondent*
No personal computer	17.4
No identification number/user number	17.4
Cost of personal computer, modem, online	17.4
No time to devote to learning	34.8
No desire to learn technology	13.0

TABLE 6
Descriptive Statistical Measures on Student Perceptions

	Group 1 (Users)		*Group 2 (Nonusers)*	
Variable	*Mean*	*Standard Error*	*Mean*	*Standard Error*
1	2.09	.125	3.13	.340
2	1.38	.076	2.04	.222
3	1.75	.105	2.96	.255
4	2.20	.128	2.39	.163
5	1.51	.089	1.78	.153
6	1.58	.106	2.57	.242
7	1.58	.099	1.48	.165
8	1.45	.106	2.61	.293
9	2.58	.137	3.48	.242
10	2.51	.149	2.83	.185
11	3.16	.134	3.13	.192
12	2.55	.162	1.43	.207
13	1.95	.105	2.13	.181
14	2.13	.140	1.70	.222
15	2.24	.151	2.96	.222
16	2.31	.164	3.87	.238
17	2.35	.120	2.17	.205

especially valuable in learning Web instructional materials in a quantitative-type course (V13).

Although the nonusers responded in a similar fashion on the importance of collecting data and the value of e-mail communication, they also thought the university should provide some type of financial assistance to help defray the costs associated with going online (V12), and they agreed that the ability of the professor to respond to their questions by e-mail was definitely an advantage (V14).[4] What is surprising about this result is that even though the nonusers were not convinced about the benefits of electronic distance learning for WBI, they did see some value associated with the e-mail service of the Internet. It would therefore seem that their resistance to WBI could be overcome if financial assistance were made available to purchase or lease a computer and related communications devices. Providing financial assistance is especially important in a predominantly commuter university where students do most of their individual learning and schoolwork off campus. PC ownership or accessibility might motivate students to become users of WBI and to not resist computer-based learning technologies.

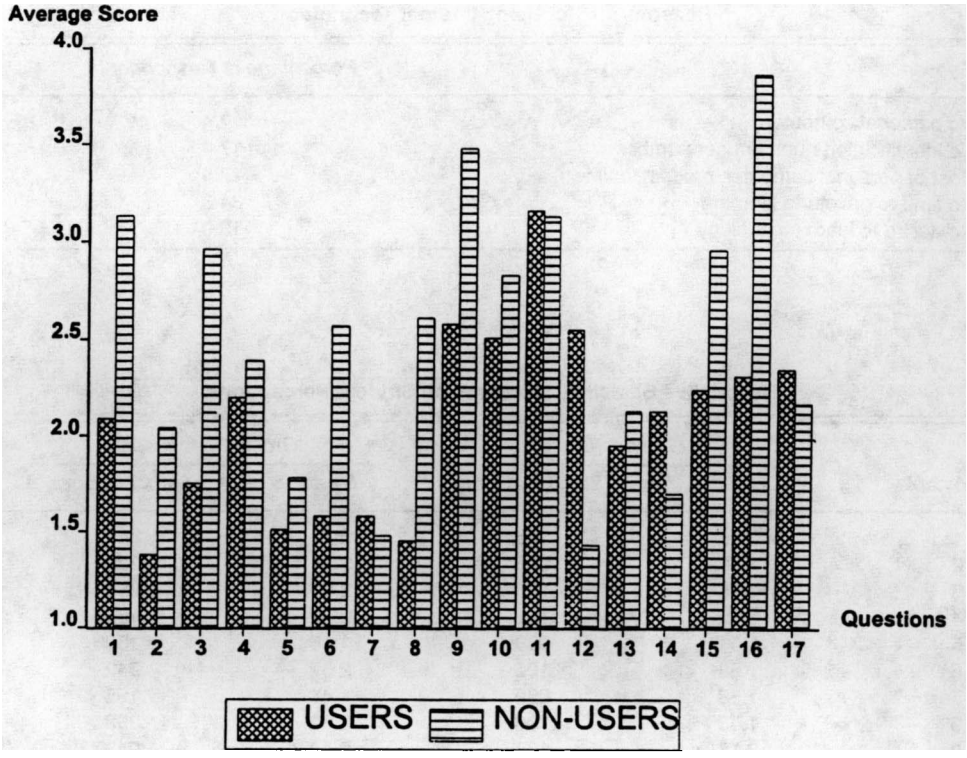

Figure 1: Graphical Presentation of Average Responses

On the other end of the scale, when average responses were 3.0 or higher, the users had only one variable. The users felt that the university did not provide adequate personnel to assist them (V11), whereas the nonusers tended to be more negative, since four variables had average scores of greater than 3.0. The nonusers also concluded that although the assistance of university personnel was adequate (V11), they did not feel that electronic distance learning would help them improve their overall grade point average (V9) or their academic performance in a quantitative course (V1). Finally, the nonusers were very adamant in their belief that WBDL should not be required for graduation from the university (V16).

The SPSS/win version 7.5 was used to derive the discriminant function coefficients. Table 7 presents the standardized canonical discriminant function coefficients. The group centroid for Group 1 (users) was –.74448; for Group 2 (nonusers), a centroid of 1.78028 was obtained.

Of the seven variables that tended to distinguish the users from the nonusers, three appear to be the most powerful (17, 12, and 5). The users of the Internet technology liked the ease with which they could communicate with the professor and other students and receive feedback when they experienced course questions or difficulties (V17). This group also felt strongly that the university should not provide financial assistance for computer purchases or for other ancillary expenses (V12). The third major distinguishing feature was the group's belief that the data collection procedure was greatly facilitated by using the Internet (V5).

TABLE 7
Discriminant Function Coefficients

Group 1		*Group 2*	
Variable	*Users*	*Variable*	*Nonusers*
17	−.64565	16	.61020
12	−.46902	3	.50589
5	−.46443	6	.29928
14	−.26449	7	.27592
10	−.14785	2	.22704
8	−.09345	9	.16335
15	−.03840	1	.12751
		4	.04783
		13	.01031

TABLE 8
Classification Results of Discriminant Function

	Predicted Group Membership	
Actual Group	*Group 1*	*Group 2*
1	92.7%	7.3%
2	21.7%	78.3%

Other differentiating opinions covered issues such as the usefulness of the instructor responding via e-mail (V14), the adequacy of the telecommunications facilities provided by the university (V10), the importance of distance learning for future intellectual pursuits (V8), and a preference for WBI to be available in the course (V15).[5]

The most powerful discriminator for the nonusers was their belief that a course in WBI should not be required for graduation (V16) and their reluctance to recommend its use to other students (V3). Discriminators with smaller degrees of differentiation included the doubt that the benefits exceeded the costs (V6), the value of e-mail communication (V7), the value of the Internet in providing general information (V2), and the value of the Internet in improving their performance in a quantitative course (V1) or their grade point average (V9).

Table 8 presents the classification results from applying the discriminant function to the two groups. The discriminant function correctly classified 92.7% of the those in Group 1 (users) and 78.3% of those in Group 2 (nonusers). The overall percentage of grouped cases correctly classified (88.46%) bodes well for the predictive efficiency of the discriminant function. Thus, it is quite suitable for use in predicting the usability of WBI by students taking these courses in the future.

SUMMARY AND CONCLUSIONS

In this study, the specific research question was to determine student perceptions about electronic distance learning or WBDL in teaching quantitative economics courses. How do students feel about integrating WBI into the traditional classroom environment in which

lectures/handouts have historically been the primary method of delivering course content? A secondary issue was to identify perceptions between users and nonusers concerning the use of Internet technology as tool of electronic distance learning, and the characteristics that led to these perceptions.

The perceptions of the users and nonusers differed not only when descriptive statistical methods were used but also when statistical inference techniques were applied to the data. In a strictly descriptive approach, the users tended strongly to agree that electronic distance learning was a good method for obtaining general information and collecting data and was invaluable for mastering the materials in a quantitative-type class. In addition, they thought that the economic Web site was an effective means of reinforcing in-class lectures and communication with the instructor, and a cost-effective way of delivering and receiving economic knowledge necessary for future educational accomplishments. They would recommend its use to others.

Using descriptive statistical tools, the nonusers felt strongly that the university should provide financial assistance to people who want to purchase the necessary equipment to go online. They realized the advantage of having their professor be able to respond via e-mail. However, they were not convinced that participation in Web-assisted education would improve their overall grade point average or their performance in a quantitative course. Most definitely, however, the nonusers believed that a course using WBI should not be required for graduation.

Likewise, when the statistical procedure of discriminant analysis was applied to the data set, interesting conclusions were obtained. The most powerful discriminator for those who used the Web site included the ease with which answers to questions could be obtained, the view that the university should not provide financial assistance, and the ease of collecting data from the Internet's digital library. The most powerful discriminators/predictors for the nonuser group focused on their insistence that a course based on Internet technology should not be required for graduation. They would not recommend electronic distance learning to someone else.

Students who are exposed to electronic distance learning find it to be a valuable supplement in their educational experience. The nonusers provide an interesting challenge to university administrators and faculty. Perhaps little can be done to encourage the use of WBI if the student perceives that he or she does not have enough time to devote to learning (in the traditional mode) and using the Internet. However, if the nonuse is attributed to economic considerations such as cost of securing a personal computer or modem, or ancillary expenses, perhaps the university could in conjunction with local financial institutions establish programs that would help alleviate the fixed and variable costs associated with going online. These are management and leadership issues/problems that confront university administrators as a result of the increasing importance of individualized telecommunications-based learning and are likely to escalate with a transition of continuing education programs from a periphery to a central university activity (Denning, 1996; Duning, Van Kekerix, & Zaborowski, 1993). One possible solution would be to have numerous points of contact on campus where students would have the opportunity to go online without incurring any expense associated with using the Internet/IT.[6] Also, workshops should be organized so nonusers can become familiar with the Internet-related equipment and semantics. In addition, outreach centers could be established and equipped with PCs connected to the Internet to facilitate access to Web materials. Where possible, high-speed computers and large monitors or projection screens should be installed in classrooms (and wired to the Internet) so that the instructor can display the instructional materials from his or her Web site during lectures via transmission control protocol/Internet protocol (TCP/IT) connection. Such a strategy may

provide the prodding necessary to force Internet illiterates (or "non-Netizens") to become active participants in the use of computer- and communications-based technologies. From our experience, having the faculty do so by using a laptop computer and a portable projector (or a laptop that runs a personal Web server) consumes the class time and has little or no motivational impact on the non-Netizens.

For electronic distance learning to become even more effective as a teaching tool, attention must be given to user and nonuser faculty as well. Even for faculty who use the Internet/IT technology for teaching, some problems are inevitable. First, the time costs of learning to compose Web pages in hypertext markup language (html) can be substantially high initially. Once all the instructional materials are placed on the Web maintenance for currency, increased Internet capabilities (such as adding links to new sites) and (enhanced) pedagogical design of the Web pages for improved ease of use become routine tasks and are less costly timewise. The second problem is the difficulty of incorporating equations into Web pages. This is a serious handicap, especially for faculty who teach quantitative courses. As of this writing, the World Wide Web Consortium (W3C) has yet to come up with any html standard for incorporating notations and equations into Web pages. Consequently, the present generation of Web-authoring software cannot embed notations in Web pages. This may change in the near future considering the historic pace of innovation in Web technology since 1995. The third problem is faculty resistance due to lack of modern Internet/telecommunications-related equipment (such as a high-speed Pentium PC with multimedia capability and wired to the local network for direct access to the Internet) and lack of formal exposure to Internet technologies. These are financial issues that pose serious challenges to academic administrators if the nonuser faculty are to be encouraged to become acclimated with the Internet technology.

It has been observed that although the implementation of new technologies is growing, the rate of adoption by faculty is generally quite low (McNeil, 1990). A reason commonly given for this disappointing rate of adoption is negative attitude and resistance of faculty (Gunawardena, 1990).[7] A simple course of action would be for the administration to provide the faculty with the right kind of computer/telecommunications equipment and develop a comprehensive marketing plan that entails forums and workshops for explaining the benefits of this cutting-edge technology to the faculty (as well as students). The emerging trend seems to be that individuals of all walks of life are showing increasing interest in becoming Internet literate; this frenzy stems from the growing awareness that the global electronic commerce is not a passing fad. We would argue that if the faculty were provided with the proper equipment, welcome or not, they would find it advantageous to master the Internet/IT skills not only for delivering knowledge in the form of Web-assisted education in the courses that they regularly teach but for gaining access to the global electronic markets of the future. The phenomenon of faculty and student resistance to the use of individualized computer-based technologies to promote Web-assisted education is a fertile area for future research.

NOTES

1. In an open university (such as the British Open University, started in 1968), students study exclusively at their own home, at convenient times selected by the student. Printed material is still the norm, although recent courses have employed increasing levels of electronic distance learning technologies (Bork, 1997).

2. The YSU computer center provides students in these classes with an account number and a password that allow them access to the Internet either while on campus (from the computer labs) or from off-campus locations using the point-to-point protocol (PPP) connection to the Unix host servers. Access from the labs are free; the dial-in cost to the Unix servers is the phone charge while online. Students are also provided with the instructions for setting

up the PPP connection. Because most of the students are commuters, those who elected to use the economics Web site bought access from their local Internet service providers (ISPs) to avoid paying the long-distance phone bills.

3. The CAI method, traceable to the work of Patrick Suppes and Richard Atkinson at Stanford University in 1963, was developed as computer-based, individualized instructional strategies that allowed learners to correct their responses through rapid feedback; mastery was obtained through drill and practice by allowing the student to take an active role in the learning process (Suppes, 1980). The increase in the application of CAI got a boost in 1975 as mainframe systems shifted to low-cost microcomputers and personal computers and has remained a popular teaching tool in mathematics and reading (Molner, 1997). Unfortunately, the CAI revolution has not generated enthusiasm in the teaching of economics (Lovell, 1991; Porter & Riley, 1992).

4. The nonusers communicated with the authors via e-mail even though they did not use the economic Web site. The users communicated more often; some even expressed outright pleasure of surfing the Internet to learn the course materials (these e-mails are available and can be obtained from the authors). Students' recognition of the e-mail's importance mirrors the finding by Murphy and Terry (1997) in which 80.7% of the faculty (a major player in the distance learning equation) indicated that e-mail was an important facet of electronic distance learning.

5. During personal discussions with the students, many of them indicated that they printed the Web materials and used them as their notes. They also reported spending substantial amounts of time on the Web site studying the solutions to the sample problems and the definitions in the glossary of statistical terms to prepare for examinations.

6. See Garson (1996) for a detailed discussion of the economics of going online from the viewpoint of the administration.

7. Our ongoing project will focus on faculty attitude and resistance toward Web-assisted education.

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