

COMPARISON OF PRIMARY VS SUPPLEMENTARY DELIVERY OF INSTRUCTION VIA THE WORLD WIDE WEB IN AN UNDERGRADUATE AGRICULTURAL COMMUNICATION COURSE: EFFECTS ON ACHIEVEMENT AND ATTITUDE

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Abstract

The purpose of this study was to determine the effectiveness of two methods of instruction in an undergraduate agricultural communication writing course on students' achievement and attitudes. The two methods of instruction were dependent Web-based instruction with a laboratory and fully developed Web-based instruction. Dependent Web-based courses have major components on the World Wide Web to assist classroom instruction. Fully developed Web-based courses offer the entire course on the World Wide Web. Students' achievement was measured from points obtained from: five major written assignments, one application question on the midterm examination, and a major class project. Students' attitude was determined from a semantic differential instrument developed to measure students' attitude toward writing, learning about writing, computers and the Internet. The experimentally accessible sample size was small ($n = 32$). The data collected to measure students' achievement and attitudes violated the assumption of normality and data was ranked according to the RT-1 method. A multivariate analysis of variance (MANOVA) was conducted on ranked data to determine the effect of method of instruction on achievement. A multivariate analysis of covariance (MANCOVA) was conducted on ranked data to determine the effect of method of instruction on students' attitude toward writing, learning about writing, computers, and the Internet. No statistically significant differences were found between method of instruction on students' achievement or attitudes.

Introduction and Theoretical Framework

For 50 years people have conceived of a universal information database that would link to other pieces of information for quick retrieval by the user. Only in the last few years, implementation of this idea has been realized through the use of the World Wide Web (abbreviated as WWW or Web) (Hughes, 1993). Owston (1997) stated that the Web has prompted teachers to rethink the nature of teaching and learning and boundaries associated with the classroom and class schedules.

According to Bridwell, Bretz, DeVries, King, and White (1996), learners' needs are changing because today's society is more mobile. To accommodate these changes in society, learning methods should become more portable and flexible. Martin (1995) noted that, as students change, then so must the courses which schools offer. Martin also suggested that educators can use computers and information technologies in innovative ways to enable course material to meet these changes.

Using the WWW and other Internet components has been a relatively new concept for educators. The WWW has allowed instructors to provide course material through multiple media (e.g., multimedia), supply links to many other resources related to the course, communicate electronically with students, obtain assignments electronically, and issue exams. Additionally, the WWW has opened up new resources that provide information to a wide audience (Owston, 1997).

Types of Web-Based Instruction

There are many variations in terminology that describe types of Web-based instruction. Oregon State University (1996) defined four types of courses on the Web: fully developed, dependent, supplemental, and informational. A fully developed course offers the entire course on the Web; a dependent course offers major components of the course on the Web; supplemental courses include information on the Web that contain links to other related resources; and informational courses offer only course information on the Web. This study used two of the four types of Web-based instruction, dependent Web-based instruction and fully developed Web-based instruction.

The introduction of Web-based instruction has allowed instructors to present information through text, graphics, audio and video and allows learners to choose a variety of ways to pursue course material (Liu & Reed, 1994). Exploring the Web has inspired students to weigh evidence, filter information, and judge authenticity of data. The Web has also encouraged students to compare viewpoints, analyze and synthesize information, and develop opinions. Researchers have suggested that these activities play a role in development of critical thinking and problem solving skills. Educators, realizing the potential, have begun devising ways to capitalize on this technology (Owston, 1997).

To reinforce the use of computers in agricultural education classrooms, Nordheim and Connors (1997) investigated the utility of computers in the classroom as perceived by agriculture teachers. More than 81% believed that computers were essential to their agriculture classrooms. Eighty-five percent reported that computers made students more efficient. More than 85% felt that students should learn to use the Internet with 75% agreeing that the Internet should be used in agricultural classes.

During the spring semester of 1997, Roberts (1997) conducted a formal evaluation on students enrolled in AEE 3203 Introduction to Technical Writing in Agricomunication.

The responses to questions about demographics characteristics revealed that 67% of the participants ($n = 47$) had a computer at home and 48% had access to the Internet from home. Previous computer experience was also evaluated and found that 98% had used a word processor, 30% had used presentation graphics software and 30% had used some form of file transfer protocol.

The freedom of when and where to study and complete assignments appeal to many learners. By incorporating electronic chat lines and bulletin boards, students are also able to maintain direct communication with the instructor, obtain peer group support, and gain from questions asked by others (Webb, 1997). This learning environment relies on electronic communication which appeals to learners that are that are not comfortable with oral communication (Roberts, 1997).

Students' Achievement and Attitudes

A study conducted by Hart (1995) showed no evidence of increasing teaching effectiveness using dependent Web-based instruction. However, students indicated enjoyment in learning from the Web and that using the Web increased dissemination of information efficiency.

In a quasi-experimental study conducted by Day, Newman, and Raven (1996), student achievement and attitudes were compared using dependent Web-based instruction and traditional instruction in an undergraduate Introduction to Technical Writing in Agricomunication course taught at Mississippi State University. Students in the group receiving dependent Web-based instruction scored significantly higher on the technical report than those receiving traditional classroom instruction. Also, students in the group using dependent Web-based instruction showed improved attitudes toward writing, learning about writing and the Internet. No group differences were found on students' attitudes toward computers.

In a study by Goldberg (1997) students were divided into three groups in which three types of instruction were compared. Group one received online instruction only (no lectures); group two attended lectures and had no access to the online information; group three had access to both lectures and online information. Goldberg found no significant differences in academic performance between groups, however, the highest mean was in group three with group one and two performing roughly equal. The group receiving online instruction reported that extra motivation and responsibility were required and that they disliked not meeting with other students. However, 90% indicated they would take another course taught online and showed a high degree of satisfaction with the delivery technique (Goldberg).

Statement of the Problem

Advancements in communication technologies have created many challenges for educators. Faculty members and administrators have expressed concern about the effect technology advancements may have on providing quality education.

Many instructors that have explored educational applications of the WWW primarily describe observations of instructional effectiveness (Carvin, 1998; Corderoy, & Lefoe, 1997; Oswton, 1997). Others have addressed the issue of providing effective features in the Web site design (Comber, 1995; Martin, 1995; Gibson, 1997). Although, some studies have shown that distance learning through the WWW occurs at similar levels to that of traditional classroom learning (Goldberg, 1997), overall, little empirical documentation of the educational effectiveness has been available (Jacobson & Spiro, 1995).

Purpose

The purpose of this research was to compare the effectiveness of fully developed Web-based instruction and dependent Web-based instruction in an undergraduate technical writing course on students' achievement and attitudes. Therefore, the following null hypotheses were tested in this study:

H₀-1: For students in AEE 3203-Introduction to Technical Writing in Agricomunication, there will be no difference in group means between students taught using dependent Web-based instruction with a laboratory and those taught using fully developed Web-based instruction on points obtained from:

1. Written assignments
2. Technical report
3. Midterm Memo

H₀-2: For students in AEE 3203-Introduction to Technical Writing in Agricomunication, there will be no difference between students taught using dependent Web-based instruction and fully developed Web-based instruction on the following attitude scales:

1. Attitude toward writing
2. Attitude toward learning about writing
3. Attitude toward computers
4. Attitude toward the Internet

Implications

New developments in communications technologies have created a new environment for teachers and researchers alike. The potential for using the WWW in agricultural education is tremendous. Much attention has been directed to the technology itself; however, method of delivery, and the overall effect that Web-based instruction will have on distance education has created a great deal of interest. Therefore, it is important to identify obstacles and challenges that faculty members in colleges of agriculture will be faced with when incorporating electronic teaching technologies to ensure the success of distance education efforts.

Research Procedures Used

The design of this study was experimental. There were two groups that participated in the study. Students were randomly assigned to groups and groups were randomly assigned to treatments. The experimental group was assigned to fully developed Web-based instruction. The control group was assigned to dependent Web-based instruction.

Population and Sampling

The target population of the study was any undergraduate student choosing to enroll in AEE 3203-Introduction to Technical Writing in Agricommunication at Mississippi State University. Sections four (lecture) and five (lab) taught on Wednesdays, 5:00-7:50 and 8:00-8:50, respectively, were chosen for the experiment. The sample of subjects was drawn from students enrolled in AEE 3203-Introduction to Technical Writing in Agricommunications at MSU in the spring semester of 1998, and included 32 undergraduate students.

Description of Treatment

Both groups had access to the AEE 3203 Web site. The information provided on the AEE 3203 Web site included: PowerPoint® slides, outlines of PowerPoint® slides, RealAudio®/Video of lectures, assignments, score sheets, and syllabi. It also offered step by step instructions for many computer procedures necessary to complete assignments.

Control group. The method of instruction for the control group was dependent Web-based instruction. This type of instruction has been considered the traditional instruction method for the course and has been used since the summer term of 1995 (Day, 1996).

Students in the control group met in a traditional computer lab once per week for 100 minutes of lecture and 50 minutes of laboratory. The primary medium used during the lectures was outlines of course content in the form of PowerPoint® slides. Scored assignments were submitted to the instructor in hard copy format during regular class meetings.

In the lab sessions, students used computers to complete practice assignments that were modeled similar to the graded assignments. Upon completion of the lab assignment, each student received feedback from the instructor on the correctness of their assignment and made revisions accordingly.

Experimental Group. The method of instruction for the experimental group was fully developed Web-based instruction. This type of instruction had never been used or tested as a type of instruction for AEE 3203-Introduction to Technical Writing in Agricommunication at Mississippi State University.

Students in the experimental group were required to meet four times during the semester: (a) to review the syllabus and course requirements, (b) to take the written midterm examination, (c) to present their technical report topic, and (d) to take the written final examination. To ensure that students in the experimental group were accessing and reading the course material on the Web site, electronic reviews for each course unit were constructed and electronically submitted each week. Scored assignments were submitted to the instructor electronically according to syllabi deadlines. Although physical meetings with the instructor were allowed, the students were expected to use the 3203 Web site as the primary source for information and correspond electronically with the instructor.

The primary medium used to obtain information to complete practice lab assignments was the AEE 3203 Web site and pages specifically constructed for each lab assignment. As a reminder, students in the experimental group were sent an email message every Monday concerning the review and lab assignment for the week and the due dates. Students submitted lab assignments by attaching the document to an email message and sending it to the instructor. The instructor critiqued each assignment, made notations within the submitted document and returned it through an email attachment to the students for review.

Data Form and Collection

Achievement. To determine students' achievement, a posttest-only experimental design was used. The scores from five writing assignments given throughout the semester totaling 400 points, a technical report worth 250 points and an application question on the midterm (memo) worth 50 points were used to determine achievement.

Achievement was measured from writing assignments constructed by AEE 3203 instructors that incorporated performance-based, task-specific assessment. The assignments tested concepts taught during lecture and reinforced

during the laboratory. Composite scores from the assignments were used to determine the overall main effects of method of instruction on achievement.

Baker, O’Neil, and Linn (1994) defined performance-based assessment as a type of testing that allows students to demonstrate understanding and skill in applied, procedural, or open-ended settings. Performance-based assessment approaches offer effective strategies for generating useful assessments (Baker et al.) especially for task specific writing assessment (Dunbar, Koretz, & Hoover, 1991).

Attitude. The effect of method of instruction on students' attitude was investigated using a pretest-posttest control group design. Scores obtained from a semantic differential instrument given the first time the student attended class and last day of class were used to determine students’ attitude toward writing, learning about writing, computers, and the Internet.

The semantic differential has been used regularly by psychologists because it is considered flexible in application and designed to measure a variable in human behavior, “meaning” (Snider & Osgood, 1969). Each instrument contained 10 sets of bipolar adjectives with a seven-space scale between for students to indicate where their feelings existed. The bipolar adjectives used in this instrument were based on Snider and Osgood’s recommendations for coordinating variables that measure basic human judgements. All four instruments contained the same 10 sets of adjectives.

The content and face validity of the instruments were based on its ability to measure general attitudes toward a topic and established by graduate students and faculty in agricultural education. Reliability estimates for the semantic differential instrument was obtained through use of a pilot test conducted during the summer of 1995 in sessions of AEE 3203. Estimated internal consistency of total scores using Cronbach’s alpha were .96 for the instrument developed to measure students’ attitude toward computers, .81 for the instrument developed to measure students’ attitude toward writing, .84 for the instrument developed to measure students’ attitude toward the Internet, and .87 for the instrument developed to measure students’ attitude toward learning about writing (Day, 1996).

A multivariate analysis of variance (MANOVA) was used to compare the effectiveness of the teaching method on student achievement. A multivariate analysis of covariance (MANCOVA) was used to compare teaching method on students’ attitude toward writing, learning about writing, computers, and the Internet.

Findings

Thirty-two students consented to participate in the study. Students randomly assigned to dependent Web-based instruction (control group) totaled 16. The average age was 23 years ($SD = 3.27$) and included one female and 15 males. Students assigned to fully developed Web-based instruction (experimental group) also totaled 16. The average age was 22 years ($SD = 2.54$) and included two females and 14 males.

During the course of the semester, one student dropped out of the dependent Web-based course and two students dropped out of the fully developed Web-based course. Therefore, data analysis was conducted on 15 students in the dependent Web-based course and 14 students in the fully developed Web-based course.

The colleges that were represented in the control group after the drop outs were excluded from the data ($n = 29$) included seven students from College of Agriculture and Life Science (CALs), seven students from the College of Engineering (CE) and one student from the College of Forest Resources (CFR). The experimental group included one student from CALs, twelve students from CE and one student from CFR (Table 1).

Table 1.
Colleges Represented in the Study ($n = 29$)

Student Classification	Control			Experimental		
	CALS	CE	CFR	CALS	CE	CFR
Sophomores	1	0	1	0	1	0
Juniors	2	0	0	0	4	0
Seniors	4	7	0	1	7	1
Total	7	7	1	1	12	1

Note. CALs = College of Agriculture and Life Sciences, CE = College of Engineering, CFR = College of Forest Resources

Descriptive data of variables used to determine the effect of method of instruction on student achievement was summarized in Table 2 and include: (a) summed scores from five writing assignments, (b) scores on a technical report, and (c) scores from a memo on the midterm examination.

Students taught using dependent Web-based instruction (control) yielded a mean of 366.93 ($SD = 19.52$) out of a possible 400 on the writing assignment, 235.13 ($SD = 11.27$) out of 250 on the technical report, and 17.67 ($SD = 1.45$) out of a possible 20 on the midterm memo. Students taught using fully developed Web-based instruction (experimental) had a mean of 353.79 ($SD = 20.42$) out of a possible 400 on the writing assignments, 216.64 ($SD = 26.34$) out of 250 on the technical report and 16.57 ($SD = 1.74$) out of a possible 20 on the midterm memo.

Table 2

Descriptive Data from Raw Scores Used to Determine Effect of Teaching Method on Student Achievement

Variable	Control			Experimental		
	M	SD	n	M	SD	n
Writing assignments	366.93	19.52	15	353.79	20.42	14
Technical report	235.13	11.27	15	216.64	26.34	14
Midterm memo	17.67	1.45	15	16.57	1.74	14

Shapiro-Wilk tests of normality revealed that the scores on one variable used to access achievement, the technical report, violated the assumption of normality at the .05 *a priori* alpha level. Therefore, to correct the assumption problem of normality, the dependent variables used to measure achievement were converted to ranks using the RT-1 method as described by Conover and Iman (1981). The ranking conversion process was executed using SPSS 7.5® (Statistical Package for Social Science).

Test of H_0-1

The first null hypothesis that of no difference between method of instruction on students' achievement was determined from points obtained from written assignments, technical report, and a midterm memo given during the midterm examination. This hypothesis was tested by running a MANOVA on ranked scores at the *a priori* level of less than .05. The two levels of instruction were dependent Web-based instruction and fully developed Web-based instruction.

The MANOVA main effects test for teaching method yielded a Wilks' lambda of .73, $F(3, 25) = 2.98$ that was not significant at the *a priori* alpha level of $<.05$ ($p = .05$) (Table 3). The multivariate test of significance revealed no differences between the two methods of instruction therefore, the null hypothesis was retained.

Table 3

Summary Table for the Multivariate Test of Significance for Students' Achievement by Teaching Method

Test	Value	Exact F	Degrees of Freedom		Significance of F Statistic
			Between Group	Within Group	
Wilks' lambda	.73	2.98	3	25	.05

These results indicated that no statistically significant differences were found on the ranks of the scores from the three types of assignments, regardless of teaching method. Therefore, students enrolled in AEE 3203 fully developed Web-based course had similar achievement level to those enrolled in the dependent Web-based course.

Test of H_0-2

The second null hypothesis, that of no difference between method of instruction on students' attitude was determined from four sets of total points obtained from a semantic differential instrument designed to measure students' attitude toward writing, attitude toward learning about writing, attitude toward computers, and attitude toward the Internet.

The data collected from the semantic differential instrument designed to measure students' attitude toward writing, learning about writing, computers, and the Internet violated the assumptions of normality. Therefore, to correct the assumption problem of normality, the dependent variables used to measure achievement were converted to ranks using the RT-1 method as described by Conover and Iman (1981). The ranking conversion process was executed using SPSS 7.5® (Statistical Package for Social Science).

A MANCOVA was conducted on the ranks of scores to compare the groups on adjusted means on students' attitude toward writing, learning about writing, computers and the Internet. The MANCOVA yielded a Wilks' lambda of .96 $F(4, 20) = .20$ that was not statistically significant at the *a priori* alpha level of less than .05 ($p = .94$) (Table 4).

Table 4

Summary of Multivariate Analysis of Covariance Test of Significance for Students' Attitude by Teaching Method

Test	Value	Exact F	Degrees of Freedom		Significance of F Statistic
			Between Group	Within Group	
Wilks' lambda	.96	.20	4	20	.94

The results from the ranks of scores indicated that students' measured attitude toward writing, learning about writing, computers and the Internet was not statistically significantly influenced by teaching method. Therefore, students in the fully developed Web-based course had similar attitudes to those in the dependent Web-based course.

Conclusions

This research showed that students participating in the study were equally successful in terms of achievement, regardless of teaching method. The results are consistent with a similar study conducted by Goldberg (1997) that compared fully developed Web-based instruction, dependent Web-based instruction, and lectures without Web-based instruction. Goldberg's findings showed no statistically significant difference in academic performance, regardless of teaching method.

Recommendations

One of the advantages of providing instructional information on the World Wide Web is accessibility. That is, it makes education more attainable by people. The advantages of accessibility, along with the use of multimedia and interactive devices, offer many educational advantages.

Unlike traditional distance educational learning environments, the WWW can provide live and timely interactions between students and teachers. Interactive mechanisms on the WWW can help overcome the distance part of distance education by providing communication channels for students, regardless of location. Additionally, students living off campus relish the opportunity to take college credit courses without having to travel long distances. The WWW provides a learning environment that enables the distance learner to access course information at home, at any time, without interfering with other job or family commitments.

The WWW also offers advantages for high school students and adults seeking a high school diploma or equivalent. For high school students, the WWW could provide fully developed Web-based courses in subjects their own school doesn't offer. For adults, the WWW could provide courses to complete their high school education and prepare for the GED high school equivalency exam.

Colleges and universities have the responsibility of satisfying student needs. The additional information the WWW provides and the flexibility of accessing the information appeals to many students, particularly those from non-English speaking backgrounds. When course information is available on the WWW, students can practice, repeat, or make up lessons easier and turn in assignments without having to commute across campus'. Electronic communication with the instructor and other students also offers a tremendous advantage to college campus students and increasing student satisfaction and, possibly, motivation.

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