AN EVALUATION OF A DISTANCE EDUCATION COURSE DESIGN FOR GENERAL SOILS

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Abstract

The purpose of this study was to evaluate a distance education course design with respect to both educational effectiveness and learner satisfaction. The findings support the large body of literature indicating that distance delivery, regardless of media or technology used is not by itself a contributing variable in student achievement (Russell, 1998). The course design developed for the delivery of this course over distance accomplished the primary objective of creating a location-neutral learning experience for the students. Students performed equally well regardless of location or method. Learners completing the course were satisfied with their experience overall. There was no significant difference in learner satisfaction found between the students collocated with the instructor and the distance learners. The literature supports a conclusion that student-student and student-instructor interaction is positively correlated with learner satisfaction (Fulford & Zhang, 1993; Garrison, 1990; Ritchie & Newby, 1989). This study clouds rather than clarifies that conclusion.

Introduction and Theoretical Framework

Instructional design is not a new concept. It is, however, relatively new to higher education. Dick and Carey (1996) asserted that the field of instructional design continues to grow as an area of study and as a profession. The growing popularity of instructional design has been influenced in part by the growing popularity of distance education. According to Willis (1995), "This process [instructional design] is essential in distance education, where the instructor and students may share limited common background and typically have minimal face-to-face contact" (p.3). In colleges of agriculture, assistance with instructional design remains a rarity. Murphy and Terry (1998) found that agricultural instructors at Texas A&M University were not confident in their methodological ability to deliver courses over distance, and that they did not perceive that resources to assist them were readily available.

Robert Gagne is well known in the field of instructional design for his nine events of instruction (Gagné, Briggs, & Wager, 1992). In order to serve learners located at multiple locations, the course design evaluated here called for the chronological disassociation of some of these events of instruction. This separation in time has, as expected, increased the flexibility of scheduling for students. Of interest to the researcher was (a) any affect it may have had on the instructional effectiveness of the course as measured by learning outcomes and (b) the learners' perceptions of the quality of the instruction.

Individual differences among learners contribute to differences in achievement (Threlkeld & Brozoska, 1993; Moore & Kearsley, 1996). Dille and Mezack (199 1) concluded that students found in distance education settings tended to out-perform traditional students, and that their greater age and experience were contributing factors. Bernt and Bugbee (1993) found that students entering a course with lower levels of education are "at risk primarily because they lack [the] metacognitive or executive skills for approaching coursework and examination-taking" needed to be successful. The literature warns us against

developing a model of the distant learner, indicating that the diversity of persons served makes this dangerous. At the same time, there is widespread agreement that "research that concentrates on individual differences and their impact on the learning process may prove more fruitful" (Threlkeld & Brozoska, 1993, p. 49).

Russell (1998) provided a metaanalysis of over 240 studies indicating that in properly designed learning environments, the methods employed to overcome geographical or chronological distance produce no significant differences in learner achievement. While achievement may be unaffected by these methods, learner satisfaction has been found to be related to interaction. Learners prefer a setting that includes interaction between and among other learners and instructors (Fulford & Zhang, 1993; Garrison, 1990; Ritchie & Newby, 1989). One way to organize thinking about interaction is through the theory of transactional distance.

Michael Moore (1980) introduced the concept of transactional distance. He and Kearsley suggested that transactional distance be included as a variable in the analysis of distance education courses and programs (1996). Transactional distance is a measure of distance as a "pedagogical phenomenon" (p.200). It involves the interplay among the instructors, the learners, the content, and the learning environment. There is always some transactional distance involved, even when the students are collocated with the instructor. By this measure, some "on-campus" courses designs have greater transactional distance, are in fact more distant, than some courses designed to use technology to overcome geographical and chronological distances.

Miller (1995) identified several learning strategies that the graduates of an off-campus agricultural degree program found useful in learning from videotape. While conceding that more research was needed to determine which strategies were most effective, he concluded that the graduates had learned to view tapes in segments, pause the tape to think or take notes, and to view the tape more than once to reinforce learning. Threlkeld and Brozoska (1993) suggested that individual learner differences might be important in determining learner success. They went on to describe successful adult distant learners as mature, highly motivated, flexible and self-disciplined. Moore and Kearsley (1996) posit that describing successful distance learners within the context of a specific distance delivery medium, such as videotape, may be more valuable.

Few studies have been conducted along these lines. In a study of graduate students in a compressed video setting, Jurasek (1993) found that students had a positive attitude toward both compressed video as an instructional method and the opportunities for interaction provided by the system. She found that students at the distant site had a significantly more positive attitude than did students at the origination site. There was no significant difference in the average grades earned by students at the different locations.

Ultimately, both learner achievement and learner satisfaction will be important to the long-term success of educational programs. The Boyer Commission (1998) reported, "the best teachers and researchers should be thinking about how to design courses in which technology enriches teaching rather than substitutes for it" (p.2). As the demand on faculty to make their courses available off-campus increases, the need to analyze the quality of these courses from the standpoint of both learner outcomes and learner satisfaction grows more urgent.

Purpose

The primary purpose of this study was to evaluate a distance education course design with respect to both educational effectiveness and learner satisfaction. Specific objectives of the

project were:

1. Describe the demographic characteristics of the learners.

2. Identify differences in student achievement among the Distance, Local, and Traditional groups while statistically controlling for prior knowledge, age, gender, class standing, and laboratory experience.

3. Identify variables related to student achievement other than location and method of delivery.

4. Identify differences in learner satisfaction among the Distance, Local, and Traditional groups.

Methods

Course Design: The same instructor has offered this course, General Soils, for more than 30 years. An innovative and caring educator, he is committed to quality teaching. In the spring of 1997, events conspired to create an opportunity to offer General Soils in a collaborative arrangement with another campus some 400 miles away.

Initially, the instructor was concerned with the perceived lack of instructor-student interaction possible in the distance education setting. Working with the instructional designer, the instructor estimated that in a typical week of on-campus delivery comprised of three 50-minute lecture sessions, as much as 30 minutes were spent in instructor-directed question and answer activity. Additionally, a weekly lab exercise was determined to be essential to the mastery of the instructional objectives. An important discovery for this instructor was the idea that the majority of the time spent in lecture sessions, fully two hours per week, was not interactive, and was simply the presentation of information by the instructor. The distance education team wanted to create an accessible environment that fostered student-directed learning while providing support for those learners who require more direct instruction.

The instructional team met to address these issues. The team reviewed the instructional objectives of the course and discussed how each might be accomplished over distance. It was decided that a combination of technologies would be used to create an active, "location neutral" learning environment. By location neutral, the team meant to ensure that students had an equally good learning experience regardless of location.

Three sections of this course were offered. The on-campus section, labeled "Traditional," was not changed in any way. Students met with the instructor three times a week for 50 minutes. The design agreed upon for the "Distance" delivery section included three videotape productions of the instructor's lecture presentations, averaging approximately 40 minutes each. Students viewed these at their discretion. In all, 38 presentations were produced. These replaced the presentation portion of the weekly lecture sessions in the Traditional section. Weekly hour-long interactive videoconferencing sessions were scheduled to double the amount of time available for the question-answer method in the Traditional section. A course packet, including the instructor's notes and a study guide, was printed to supplement the course text and presentations. These and other course materials were made available over the World Wide Web. To further support student-student and instructor-student interaction, asynchronous computer-assisted telecommunications using e-mail were organized. An on-site laboratory and facilitator duplicated exactly the laboratory experiences of the on-campus students.

Students attending the home campus self selected one of two delivery methods. They could enroll in either the Traditional section or in a separate section labeled the "Local" distance-

delivery section. Students in the Local section agreed to take the class as though they were at a distance, by viewing the videotapes and interacting with the instructor only by attending the interactive videoconference sessions held with the Distance students, or through the other communications technologies provided (e.g., telephone, e-mail, WWW, etc.). The laboratory sections of this class, optional in all cases, were made to be as nearly identical as possible. This self-selection of students, unavoidable in this study, limits the generalizability of the findings.

Instrumentation: In all, six instruments were used to collect data for this study, four of these measured content knowledge and two measured student satisfaction.

Four evaluation instruments were completed by students and used as quantitative measures of learning. Foshay, Silber, and Westgaard (1986) stated, "instructional designers must know the specific characteristics of the group of people who will be training" (p. 33). One key to this is identifying previously learned knowledge and skills. During the first week of class, students received a pretest to determine their existing level of competency on course objectives. The pretest instrument was developed from subject matter items selected from the comprehensive final exam. To insure item validity, knowledge items for the pretest were selected by the subject-matter expert in consultation with the instructional designer. During the semester, two more subject matter exams, identical in all three sections, were used to provide evidence of learner achievement. The comprehensive final exam was administered at the conclusion of the course. Cronbach's Alpha was calculated for each of these four instruments: The apha of these instruments were; Pretest, .87; Exam 1, .74; Exam 2 .83; Final Exam, .78.

Two instruments were used to measure learner satisfaction. At the midpoint of the course, an open-ended questionnaire was distributed to solicit qualitative student feedback. Summative, quantitative evaluation of learner satisfaction was accomplished through the standardized, university-wide, seven-question student evaluation of teaching survey. These instruments employed a five-item Likert-type response scale ranging from strongly agree to strongly disagree on the first five questions. The final two items were open-ended questions, namely, (a) "What were the most valuable aspects of this course, and (b) Give some constructive suggestions for improving the course." The reliability of the first five questions on the instrument was found to be Alpha = .95.

Data Analysis: A non-equivalent control-group design was used to summarize the data collected from student evaluations and test scores. In addition to descriptive statistics, analysis of covariance statistical procedures were used to address concerns of internal validity, ensuring that any group differences found on the measures of achievement were not due to preexisting group differences rather than to course design. The measures of student satisfaction with the course were summarized using a one-way ANOVA and Scheffé's post hoc multiple comparison. Sheffé's test is considered conservative. Pair-wise comparisons for all possible pair-wise combinations of means were calculated and the F sampling distribution was used. This approach was suggested by the extremely unbalanced nature of the sample.

Findings

Objective #1: Demographic Data: Of the 104 students who enrolled in the course, 87 cases were retained in the sample analyzed. Ten students from the Distance delivery section and two from the Traditional withdrew prior to the midterm examination and were therefore excluded. In the Traditional delivery section, five students failed to complete and submit the required Statement of Informed Consent so their data were excluded.

The relatively high withdrawal rate from the Distance section was partially explained through subsequent contacts with students who had withdrawn. The most frequent response given indicated that they were poorly advised to enter the class without having taken the prerequisites, Their early experience in the class convinced them the prerequisites listed in the course catalog were in fact necessary, and so they withdrew until such time as they could prepare themselves academically for success in the course.

Of the 87 students retained in the sample, 59 were male and 28 were female. Their mean age was 24.4 years. The mean age of the Distance students seemed significantly different than either of the course sections co-located with the instructor. This perception was confirmed through an Analysis of Variance (ANOVA) procedure and Scheffe's post hoc test. The Distance group was significantly different from both the Traditional group (p=.000) and the Local group (p=.005). These descriptive statistics for gender and age are reported in Table 1.

Table 1 Group Frequencies of Gender and Mean Age by Method/Location

Group	Males	Females	Age
	f	f	M
Traditional	48	22	22.6
Local	6	1	26.3
Distance	5	5	35.5

The class standings of the students in this course were typical of previous semesters. Coggins, (1988) found that students entering a course with higher levels of education were more likely to complete the course. There were 37 Seniors, 36 Juniors, 12 Sophomores, and two Freshman. These class standings, further broken down by Method/Location, are reported in Table 2.

Table 2. Group Frequencies; Class Standing by Method/Location

Group	Fresh	Soph	Jr	Sr
	f	f	f	f
Traditional	1	9	34	26
Local			2	5
Distance	1	3		6

Objective #2: Achievement by Location/Method: How did the students perform? The overall average score on the three knowledge instruments combined (excluding the pretest) was 77.38. Individual grand mean scores ranged from 32.00 to 99.75. The group means for achievement by location/method, and their 95% confidence intervals are reported in Table 3.

Table 3. Mean Achievement by Method/Location

Group	M	n	SE	CI_{95}
Traditional	77.25	70	1.79	80.83 - 73.67
Local	76.93	7	4.04	85.01 - 68.85
Distance	78.65	10	4.42	87.49 - 69.81

Due to the small sample size of the distance delivery group and the extremely unbalanced design, any statistical inference beyond this class is not recommended. An analysis of covariance (ANCOVA) was used to test this hypothesis. The General Linear Model procedure (GLM) procedure was employed. A model was fitted to the data controlling for prior knowledge, age, gender, class standing, and whether or not the students enrolled in the optional lab. The model was not statistically significant (p=.368). This study measured student performance in three different settings. The regression model was not statistically significant. In their cumulative effect, the covariates did not contribute to an explanation of the underlying dependent variable, student achievement. Therefore no discussion of the main effects of any of the independent variables in this model is appropriate (Table 4). While the mean

Table 4. ANCOVA of Student Achievement

Source	DF	Type III SS	M S	F	p
Corrected Model	7	1607.73	229.68	1.106	.368
Lab	1	509.25	509.25	2.45	.121
Pretest	1	173.77	173.77	.84	.363
Gender	1	359.11	359.11	1.73	.192
Class	1	241.39	241.39	1.16	.284
Age	1	2.84	2.84	.02	.907
Location	2	31.56	15.78	.08	.927

score of the Distance group was 1.4% higher than the mean score of the Traditional students, and 1.72% higher than the Local, these differences were not statistically significant, and in the opinion of the researchers, lacked any practical significance as well.

Objective #3 : Variables Affecting Achievement: The researchers were interested in the extent to which any differences in achievement could be attributed to variables other than method/location if tested individually. The group means for achievement by gender, and the associated 95% confidence intervals are reported in Table 5. While the raw means appear to be significantly different, a t-test revealed that they were not, t (85) = -1.698, p=.09. The group means for achievement by academic standing are reported in Table 6.

Table 5. Mean Achievement by Gender

Group	M	n	SE	CI_{95}
Males	75.59	59	1.98	71.63 - 79.55
Females	81.17	28	2.28	76.61 - 85.73

Table 6. Mean Achievement by Academic Standing

Group	M	n	SE	CI_{95}
Fresh	74.9	2	7.37	60.16 -89.64
Soph	72.6	12	3.57	65.46 - 79.74
Jr	77.6	36	2.46	72.68 - 82.52
Sr	77.4	37	2.72	71.96 - 82.84

The researcher was unable to detect any relationship between academic standing and achievement. While the mean score of the Sophomores was five points lower than the mean score of the Juniors, this difference was not found to be statistically significant.

The researchers were also interested in any effect on achievement based on whether or not the students enrolled in the optional laboratory sections. The 46 students enrolled in lab sections had an average score of 80.06 while the 41 not enrolled averaged 74.39. A t-test revealed that this difference was not statistically significant, t (85) = -1.851, p=.68.

Objective #4: Learner Satisfaction: Where there differences in learner satisfaction among the three groups? Students were given the seven-item, standardized student evaluation of teaching instrument during the final week of classes. All of the students in both the Distance and Local groups were present and completed the evaluation instrument. Of the 75 students enrolled in the Traditional section at the conclusion of the course, 57 were present on that day and completed the course evaluation. In all, 74 evaluation instruments were summarized, for an effective response rate of 80.43%. Total anonymity of data collection precluded using follow-up procedures to acquire data from the non-respondents in the Traditional section.

Overall, this course received a very positive evaluation. The standardized student

evaluation of teaching instrument used a five-point scale, with five being strongly agree. The lowest mean evaluation from any section was a 3.6, somewhere between "neutral" and "agree." As a group, students rated this course highly with a grand mean of 4.39.

The students in each of the three sections of the course were found to differ in their levels of satisfaction, $F_{2,73} = 5.808$, $p < .005$.

Multiple comparisons were then calculated using Sheffe's procedure for a summated scale of all five questions across each of the three sections. Alpha was established apriori at .05. Significant differences were found between the Distance students and the other two sections. On a five-point scale, Distance students rated the course a 3.74, whereas Traditional students rated it a 4.49 and Local students a 4.54.

Multiple comparisons were then calculated using Sheffe's procedure for each of the five questions across each of the three sections. Alpha was established apriori at .05. Significant differences were found between the Distance students and the other two sections in every case with Distance students agreeing less strongly. The data are summarized in Table 7.

Conclusions/Recommendations

This study supports the large body of literature indicating that distance delivery, regardless of media or technology used, is not by itself a contributing variable in student achievement (Russell, 1998). The researchers are satisfied that the course design developed for the delivery of this course over distance accomplished the primary objective of creating a location-neutral learning experience for the students. Students performed equally well regardless of location or method.

The study was also interesting for what was not found. It was surprising that enrollment in the laboratory sections failed to contribute significantly to the achievement of students in the recitation sections, regardless of delivery method. McKeachie (1994) pointed out that the effectiveness of laboratory instruction should be measured using outcomes including retention, ability to apply learning, and actual skill in manipulation of materials (p. 136). This study did not attempt to measure these outcomes; thus the actual value of the laboratory sections remains unknown. Also interesting was the lack of correlation between age and achievement.

The age of the students in the Distance section was significantly greater than that of the students collocated with the instructor, yet no significant difference in achievement was detected. The literature suggests that the "non-traditional" students often found in distance education settings tend to out-perform traditional students, and that their age and experience are contributing factors (Dille & Mezack, 1991). This study fails to support that conclusion.

The measures of individual differences in achievement among learners in this study were confined to demographic variables. Miller (1995) identified learning strategies that graduates of an off-campus agricultural degree program found useful in learning from videotape. Miller (1997) identified learning strategies that significantly reduce variability in predicting student achievement in videotape courses. A study designed to examine both demographic and learning strategy variables might prove more fruitful.

Table 7. Student Satisfaction by Question by Section

Question	Distance	Local	Traditional
The instructor prepared and organized the course effectively.	3.90[a]	4.71	4.74
The instructor provided adequate opportunity for you to be informed of your progress in meeting course goals.	3.80a	4.71	4.43
Overall, the instruction was effective.	3.60[a]	4.33	4.14
The course material seemed relevant and meaningful.	3.70[a]	4.43	4.42
Based on what I learned in this course, I would recommend this instructor to other students.	3.70a	4.71	4.52

[a]The Scheffe test revealed that this mean was significantly different from the others means for this question.
*p<.05.

Overall, the learners completing the course were satisfied with their experience. The literature supports a conclusion that student-student and student-instructor interaction is positively correlated with learner satisfaction (Fulford & Zhang, 1993; Garrison, 1990; Ritchie & Newby, 1989). This study clouds rather than clarifies this conclusion. Distance students were provided the opportunity to interact with the instructor via videoconferencing for an hour on a weekly basis. In theory, due to the question/answer format of these sessions, as well as the smaller number of Distance students, they had much more opportunity for interaction per student. Yet their evaluation of the course was significantly lower than that of the other two sections. This would fail to support the literature. However, the data collected from the Local section supports the literature. With an opportunity to interact equal to the Distance students, the Local section provided the highest mean course evaluation. In practice, the videoconferencing sessions were not well attended, but they were avoided equally by Local and Distance students. In the comments sections of both the formative and summative evaluation instruments, students at both locations failed to mention the sessions as a valuable aspect of the course.

In their (1993) study, Fulford and Zhang drew a distinction between perceived overall interaction and perceived personal interaction. Perceived overall interaction, defined as the "perceived involvement of other members of the class"(p 12) was a much better predictor of learner satisfaction than was perceived personal interaction, or the "involvement of each participant" (p. 12). Given their remote location, the Distance learners would likely be much less aware of "overall" interaction. Local students would have greater opportunity to interact with Traditional students outside of class, and thus greater opportunity for student-student interaction. Two possible methods to address this concern include making the videoconferencing sessions mandatory for Local and Distance students and organizing an on-line threaded discussion group available to all the students.

Students in distance education settings withdraw from courses at a greater rate than traditional students. Much research has been conducted to discover why (Bernt & Bugbee, 1993; Coggins, 1988; Dille & Mezack, 1991; Garland, 1993). Garland (1993) found that while a lack of time is often cited, the true reasons students withdraw form distance education courses are complex. They include a lack of prerequisite knowledge of the course content, lack of support from family and peers, procrastination, poor tutor feedback, weak goal commitment, and fear of failure. A surprising number of students withdrew from the distance delivery section of this course, and follow up contacts tend to support

Garlands (1993) conclusions. The sample of student comments in Table 8 were taken from the comments in response to the open-ended questions on the evaluation instrument and provide additional insight.

Table 8. Sample Student Responses.

	What were the most valuable aspects of this course?'	Give some constructive suggestions for improving the course."
Traditional students:	"The notes were preprinted and complemented by the computer projector." "This course was fantastically well-organized." "Instructor made old exams, study questions, and notes available." "The diversity of opportunities to learn the material, e.g. lecture, lab, web page." "Taking the lab along with the class was extremely helpful." "The close combination of the lab with the lecture material."	"Absolutely none. Excellent job." "Have the reviews for tests in the evenings. I missed a couple." "I felt that I did not learn the equations well when they are just flashed up on the screen. I think it might be more effective if you actually wrote them out as you did them." "I think the lab should be required for all students." "Field trips."
Local students:	"The video lectures worked well with my schedule." "The opportunity to take advantage of a variety of learning strategies-videos, old tests, lectures, class notes, and the textbook-were all helpful." "Watching the lectures on video-the videotape can replay missed info."	"None. Great class." "I would not recommend the video section to someone who has a hard time studying on their own."
Distance students:	"I recorded copies of the tapes so I could watch them over and over. I never would've understood the material by watching it once in the classroom." "The use of the Internet to interact, old tests, homework examples, notes, etc. on-line were very helpful." "Tapes were well done. Sample exams really helped. Web site is critical for CSI students."	"I hadn't had the math or chemistry so it was really hard." "Maybe you should require the textbook. It was expensive, but worth it." "Have more available help for the math parts of the course." "More communication with other students."

The lack of adequate academic advising was the reason most often identified. Withdrawing students also stated that the course contained much more scientific content and a greater expectation of mathematical and scientific competencies than they had expected. To address these concerns, a person could be hired by the university and housed at the distant site to assist students with academic advising and provide a local source of information to aid in their making more informed choices regarding the selection of courses offered by the university.

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