Online Students Perform Similarly to Students in a Traditional Classroom-Based Section of an Introductory Turfgrass Management Course

M.S. Schroeder-Moreno[1] and R. J. Cooper[2]
North Carolina State University
Raleigh, NC 27695-7620

Abstract

The purpose of this study was to evaluate the performance, retention of knowledge and perceptions of students enrolled in an online introductory turfgrass management course compared to their equivalent counterparts in a traditional classroom-based section of the course. This was the instructor's first attempt at developing and teaching an online course and a great majority of the students had never been exposed to online learning, thus providing a unique opportunity to assess student learning differences and perceptions in a new learning environment. Nine different evaluation methods were used to compare the groups that included quantitative measures of student performance through pre- and post-tests, three mid-semester exams, a comprehensive final exam given twice over two semesters and qualitative measures of student perceptions through post course surveys and focus groups. Students enrolled in the online course performed equally to the classroom-based students in all quantitative measurements of student performance. Despite similar performance, post course surveys and focus groups revealed that online students generally were less comfortable with their learning environment and desired more interaction with the instructor and other students. A variety of recommendations for teaching strategies were suggested by students to improve online learning.

Introduction

In recent years, increasing technology has helped to expand online learning as a significant part of the educational landscape in higher education. Online courses and programs are widely offered at many institutions and the number of students enrolled in online courses has reached an unprecedented high. A recent survey found that over 3.1 million students were taking at least one online course during fall 2005, with over 2.6 million of these students concentrated at the undergraduate level (Allen and Seaman, 2006). Despite the growing diversity of courses offered virtually, agricultural-related online courses are fewer than other disciplines. Moreover, online courses for two-year agricultural programs are especially limited. Murphy and Terry (1998) found that agricultural instructors at Texas A&M University were interested in developing distance education materials but were not confident in their ability to deliver online courses and did not perceive that resources to assist them were available.

Distance education programs and online courses are developing rapidly and many colleges of agriculture are interested in using these new technologies to expand opportunities for students that might otherwise be limited by time or geography. There is a growing knowledge of teaching strategies for agricultural distance education (Miller and Powell, 1998), yet little is known about how to successfully evaluate the effectiveness of online courses. Evaluations of students in online courses usually fall into examining three categories; the learner's process of learning, the learner's perception or satisfaction, and the learner's product of knowledge and skills (Hew et al., 2004). Because students in online courses are experiencing a new educational environment very different from the traditional face-to-face classroom environment, many studies have examined how students feel about the online course experience (Hughes and Daykin, 2002; Martens et al., 2007; Thurmond et al., 2002). Student satisfaction can enhance learning and the bulk of studies have focused on examining this sole factor for evaluating online course quality and effectiveness (McGorry, 2003). A meta analysis of 450 studies demonstrated no difference in student satisfaction for traditional face-to-face courses and distance education courses (Allen et al., 2002). Few studies have evaluated student satisfaction and performance (performance is defined as the learner's product of knowledge and skills) in a distance education course compared to the equivalent face-to-face course. Murphy (2000) found students enrolled in a distance education section of a general soils course did not differ in their mean exam scores when compared to their face-to-face counter parts but distance education students were less satisfied and had lower course evaluation scores. The distance education section of this course was not online but rather the students viewed video tapes of weekly lectures. Although students in the distance education section were provided many opportunities to interact with the instructor through video conferencing, they perceived less interaction with the instructor than

[1]Assistant Professor, Department of Crop Science
[2]Professor, Department of Crop Science, and corresponding author

students in the face-to-face section (Murphy, 2000). Little experimental evidence, however, has been generated to examine student performance between an online course and a traditional face-to-face course that demonstrates what students learned in addition to how they felt (Neal, 1998).

To address this issue with an agricultural-related course, we designed a study with an introductory turf grass management course at North Carolina State University (NCSU) during fall 1997. On the first day of class, students were randomly assigned to either an online section or traditional face-to-face section. Student performance and retention of course knowledge from each section were examined through a variety of pre- and post-tests, three mid-semester exams and a final exam given at the end the course and then again at the beginning of the following semester. Following the course, all students participated in a post course survey and a sub-set of students from both the online and classroom-based sections participated in focus groups to examine their perceptions of online learning and availability of resources to assist them. During the development of this course, the College of Agriculture and Life Sciences at NCSU had developed a number of tools and resources to assist faculty in developing new course materials using innovative technology and the internet (O'Kane and Armstrong, 1997). This online introductory turfgrass management course was one of a few courses at NCSU selected for funding and research when online learning was in the very early stages of development at the university. The primary purpose of this study was to compare performance, retention of course knowledge and general perspectives between students enrolled in an online distance education course and a traditional classroom-based course with the same content and instructor. These results from this study will be used to improve student learning for this particular online turf grass management course, but this model of evaluation can be used for a variety of different online courses.

Materials and Methods

Course Description

In this study, the introductory turf grass management course, "Turfgrasses and Their Uses," is a requirement for all freshmen entering the Turfgrass Management two year degree program at NCSU. This course is part of the Agricultural Institute program at NCSU which confers Associate of Science degrees in a variety of agricultural topics. The instructor, Dr. Rich Cooper, had been teaching this course for 12 years and this was his first attempt at developing and teaching an online course. This course emphasized basic concepts of turfgrass growth and development, soil and pest management practices and proper grass selection for golf courses, lawns, and athletic fields. Many graduates of the Turfgrass Management program go on to work and manage golf courses and this course provides them with the fundamental practices and knowledge of turfgrass management. In fall 1997, Dr. Cooper developed an online section of this course and taught it for the first time in an experimental basis to students enrolled in the traditional face-to-face section.

During the first day of class, students were randomly assigned to either the classroom or online section with 48 students in classroom-based section and 46 students in the online section. As additional students added the course and others dropped the course during the first weeks of the course, this resulted in 52 students in the classroom-based section and 41 students in the online section finishing the course. When polled on the first day of class, 90 students out of 94 claimed very little experience with the World Wide Web and no students had taken an online course before. Anticipating potential technical difficulties early on, the online students were required to attend a 90 minute training session where a distance-learning staff member showed them how to access their university computing account, navigate the course website, use email, and how to contact the NCSU Computing Services Help Desk. The course syllabus for the online group contained additional information regarding techniques for successful online learning, hardware and software requirements and computing skills required for using the online course materials. Online students were not required to attend classroom lectures and the classroom students did not have access to the online material on the course website which required a password access.

The content of the course materials were identical for both sections and the online materials consisted of PowerPoint lectures and lecture notes that online students could download and print from a course website. A general turf grass management textbook was required for both sections and the classroom students were not provided with copies of lecture notes. Online students could contact the instructor with questions either by email or meeting with the instructor during office hours. Each student also attended a two-hour laboratory session associated with the course. The laboratory content was of a practical nature and not closely associated with lecture material. Also, since the laboratory sessions were taught by several different instructors and students were not segregated into classroom or online groups, no attempt was made to analyze the differences of the laboratory grade performance for the two groups.

Evaluation Design

A total of nine instruments were used to collect data for this study, seven of which measured quantitative measures of student content knowledge and retention and two of which measured qualitative measures of student perceptions of online learning and university resources available to them. Since all

students enrolled in the course were freshman and there were only three females out of 93 students, none of the data in this study was further broken down by any demographic characteristics.

To assure that both groups of students were beginning the course with a comparable knowledge base in turf grass management, all students completed a 20 question multiple-choice quiz (pre-test) the first week of class. The pre-test included selected basic concepts which would be covered during the course. At the end of the course all students were given the same test (post-test) to quantify student learning after completion of the course. During the semester, three mid-semester exams and one final exam were also used to evaluate student performance. The three mid-semester exams only covered material presented after the previous exam while the final exam was cumulative over the entire course. The students from both sections came together physically to take the three exams and final exam during the semester. All exams were exactly the same for all students and were blindly graded without attention to section assignment. To evaluate student retention of knowledge, online and classroom-based students who subsequently enrolled in the second semester turfgrass management course were given the same final exam from the previous semester the first week of class. The difference in the final exam scores were recorded, including a total of 19 students from the previous online section and 29 students from the previous classroom-based section of the introductory course.

Two methods were used to collect and examine student perceptions of online learning and accessibility of university resources. At the end of the course, students from both sections were given a post course survey containing 44 open-ended questions that assessed students' experiences and comfort with their learning environment, their knowledge of university resources, and perceptions of interactions with other students and instructor within the course. Following the completion of the course, a smaller subsample of students from both sections participated in focus groups lead by the Assistant Director for Planning and Policy Studies at NCSU. Students volunteered themselves and there were 12 students from the online section and six students from the classroom-based section that participated in these focus groups. The instructor was not present during any evaluation.

Table 1. Mean student scores (± Standard Error; SE) for online and classroom-based students for pre-tests, post-tests, three mid-semester and the final exam given at the end of the current course (Final 1) and given again at the beginning of the following semester (Final 2). Student scores represent the mean number of questions answered correctly and each question is worth one point. The pre and post-tests were exactly the same and consisted of 20 questions and each mid-semester exam and final exam consisted of 100 questions. Results are not significantly different (NS) between course sections for any of the assessments.

Student Performance Evaluation Method	Mean Classroom-based Student Scores (± SE)	Mean Online Student Scores (± SE)
Pre-test	10.49 (0.52)	10.93 (0.48)
Post-test	16.43 (0.36)	15.88 (0.48)
Mid-semester exam 1	65.96 (3.04)	62.59 (3.48)
Mid-semester exam 2	65.06 (3.17)	70.69 (3.81)
Mid-semester exam 3	62.93 (2.93)	59.39 (3.37)
Final exam 1	68.47 (2.79)	66.95 (3.51)
Final exam 2	56.73 (2.78)	59.68 (2.92)

Data Analysis

We analyzed student pre- and post-tests and their differences (post-pre) using a one-way analysis of variance (ANOVA) using the course section as the treatment factor. Student scores for the three mid-semester exams were analyzed for treatment effects using a one-way multivariate analysis of variance (MANOVA) with course section as the between-subject factor. Student scores on the final exam during the same semester (Final 1) and scores on the repeat final exam the following semester (Final 2) were analyzed by a one-way ANOVA with course section as the treatment variable. Sample sizes may differ among analyses because not all students took all exams. Homogeneity of variance was tested with Levene's Test for MANOVA or Bartlett's Test for ANOVA. A Type III sum of squares was used for all ANOVA and MANOVA analyses and the alpha level was set at 0.05 for determining statistical significance. All analyses were performed SAS v. 8.0 (SAS, 1999). Student responses from post course surveys and focus groups were summarized descriptively around various common themes and presented in Table 2.

Results

Pre- and Post-tests

Pre-test results demonstrated that there was no significant difference in prior knowledge of course material between students assigned to classroom and online sections ($F_{1,86}$ = 0.39, P = 0.536). Online students averaged a score of 55% on the pre-test while classroom students had an average of 52%. Following the course, there was no significant difference found in post-test scores between classroom and online sections ($F_{1,74}$ = 0.90, P = 0.346). Online students averaged a score of 82% on the post-test while classroom students had an average of 79%.

While student scores on this assessment increased after completion of the course (mean difference post-test – pre-test results for online and classroom students were 4.8 and 6.3 points, respectively), no difference existed between the sections (Table 1).

Mid-semester Exams and Final Exams

Student scores on the three mid-semester exams in the classroom and online sections did not differ significantly based on MANOVA results (Wilks' λ = 0.935, $F_{3,73}$ = 1.69, P = 0.177). For mid-semester exams one, two and three; online students averaged 63%, 71%, and 59% compared to classroom student averages of 66%, 65%, and 63%, respectively. Both sections performed uniformly throughout the semester, neither increasing nor decreasing mean scores (Table 1). There were also no significant differences in the comprehensive final exam scores between classroom and online students when taken at the end of the course semester (Final 1, $F_{1,47}$ = 0.11, P = 0.737) and when re-administered at the beginning of the following semester (Final 2, $F_{1,47}$ = 0.49, P = 0.486). Online students averaged 67% for the end-of the semester comprehensive final exam compared to 68% for the classroom students. When the final exam was re-administered at the beginning of the following semester, online students averaged 60% compared to 57% for classroom students. Scores for both groups decreased in the re-administered final exam and on average students retained about 85% of what they had learned during the previous semester as indicated by final exam results (Table 1).

Post-Course Surveys and Student Focus Groups

The open ended nature of the post-course survey and the focus groups meant that statistical analyses were not possible but allowed for student feedback of their learning experiences. Student comments from the post-course surveys and focus groups are organized into three main categories: major findings from post-course surveys, challenges identified by focus groups, and suggestions for improvement from focus groups (Table 2). The comfort level of the student's learning environment was influence by course section. Online students commented that they were less comfortable and less confident in their study habitats than indicated by classroom-based students. Although online students felt generally satisfied with the accessibility of online materials, many reported that there wasn't enough new material or that the material lacked graphics or animation to keep their attention while sitting in front of the computer. Online students also commented that they felt less student-student and student-instructor interaction compared to classroom students. Online students provided many ideas for improvement including: developing opportunities for students to interact online with each other and the instructor and the option of attending classroom-based lectures.

Table 2. Student responses from post-course surveys and student focus groups organized by major findings, course challenges and suggestions for improvement.

	Summary of major findings from the post-course survey (*n* = 52 classroom and *n* = 41 online)	Course challenges identified from focus groups (*n* = 12 classroom and *n* = 6 online)	Suggestions for improvement from focus groups (*n* = 12 classroom and *n* = 6 online)
Classroom students	□ Most students felt comfortable with learning environment and confident in their study habits. □ Reported more interaction with fellow students in study groups.	□ **Interaction with course material**. Close to half of the students responded that they rarely used the textbook. □ **Interaction with instructor**. Some students noted that they had difficulties scheduling office time with instructor and they did not like to email their questions to the instructor. Many students noted that they were glad not to be in online section and that they learn better from face-to-face interactions with instructor.	□ Make the textbook optional □ Access to online course materials would be helpful as long as there was an attendance policy in place to encourage class attendance. □ More scheduled time for individual student and instructor meetings.
Online students	□ Not as comfortable with virtual learning environment and less confident in their study habits. □ Less interaction with other students and lower occurrence of study group formation. □ More dependent on prompt and frequent feedback from instructor. □ Felt computer skills improved as a result of this course. □ Overall satisfaction with accessibility of course materials online resources available.	□ **Interaction with course material**. Many reported that there wasn't enough new material; material lacked graphics and animation/video to keep their attention. Lack of motivation reported; difficult to sit in front of a computer screen for a long time. Majority of students did not take notes but printed off material and highlighted sections. Many reported studying at the last minute and putting a lot less time into the course than they should have. □ **Interaction with instructor**. Some reported that less interaction with the instructor made it difficult to identify what was important. In class, the instructor would stress certain words with his voice and emphasize selective important course materials.	□ Implement opportunities for online students to interact with and motivate each other online. □ Develop interactive tools, chat rooms for students to interact and video lectures. □ Require online students to turn in smaller assignments or questions more frequently to enhance student motivation throughout the semester. □ Encourage online students to also attend classroom lectures if they feel unconfident in online environment. □ Develop a few face-to-face meetings or activities with instructor early in the semester that enhances the student learning experience and develops a personal relationship with the online students. □ Reformat online materials so that learning objectives and main points of each lecture are easy for students to find.

Classroom-based students also indicated a desire for access to online materials. At the same time, classroom-based students indicated value in a classroom attendance policy to prevent fellow students from only getting course material online and avoiding classroom lectures.

Discussion

In this study, students were exposed to two different learning environments, an online distance education course and a traditional classroom-based course with the identical course content, course instructor and means of assessments. This allowed for a unique comparison of student performance, knowledge retention and perceptions between these two learning environments. Student scores on pre- and post-tests, three mid-semester exams and two final exams were not significantly different between the online section and the traditional classroom-based section for this introductory turf grass management course. Online students performed equally well in course knowledge and retention compared to their classroom-based counterparts, despite having an instructor new to online teaching and course development. This finding of similar student performance is particularly interesting considering at the time of this study online instruction and technological resources were not as advanced as they are today and all of the students reported no previous online course experience. This study, therefore, is most noteworthy for perhaps what was not found. The mode of education delivery and technology, were not themselves contributing variables to student achievement and outcomes in this study. These findings support a growing body of literature that suggests there are no differences in student outcomes in a distance education course compared to the equivalent face-to-face course. This has been collectively referred to as the "No Significant Difference Phenomena" (Russell, 2001). Many of the studies that support this trend, however, have limited interpretation due to inadequate research designs, lack of statistical analyses or small sample sizes (Neal, 1998). We attempted to address these issues in this study by using a sound research design including a pre-test that examined each group's beginning subject knowledge and a variety of quantitative measures to examine student learning outcomes and knowledge during and after the course. Additionally, the use of open-ended questions in post-surveys and focus groups allowed the instructor to collect student-focused ideas on ways to improve the course. We believe the assessments and methodology used in this study may be useful as a model for evaluating instructional effectiveness and student outcomes between any online course and its equivalent traditional classroom-based counterpart.

Distance education can be as instructively effective as any well-designed delivery method for providing particular types of information (Murphy, 1997). Evaluation of online courses and effectiveness are not as simple as comparing a delivery system, but the teaching methods also need to be examined. Many times these two aspects of a course are difficult to separate (Neal, 1998). We limited this study to the evaluation of the delivery system since the development of the online course during this time was very basic and consisted of putting lecture material on the World Wide Web rather than significantly modifying existing teaching methods.

Although the availability of technology and tools are rapidly expanding for online education, teaching methods need to reflect the particular environment and needs for online learners. Based on student perceptions of this online course in post-surveys and focus groups, a few recommendations arise. Most importantly, online students reported a desire for more interaction with other students and the instructor. They reported a lower occurrence of study group formation with fellow students than did classroom-based students. Student recommendations for online discussions with fellow students and instructor, chat rooms and video media reflect the need for different teaching strategies to engage their interest. Distance education must provide appropriate and ample synchronous and asynchronous interaction between faculty and students and among students to be successful (Murphy, 1997). Online students in this study reported that they missed classroom face-to-face time with the instructor experienced in the traditional lecture format. The classroom-based students also recommended that they would also like to have access to online materials if a classroom attendance policy was in place. Opportunities for students from both sections to interact (physically or virtually) could be developed. Online students also commented that the online materials alone made it difficult for them to discern what was most important to focus on for exams. To aid students in prioritizing information in the subsequent online offerings, the instructor added a section title "Learning Objectives" at the beginning of each online lecture topic. Students reacted very positively to having a set of well defined objectives to guide their study in subsequent offerings.

Online students also suggested the development of methods to encourage and motivate students to stay engaged with the online material. Online students commented on feeling less confident in their study habits and tended to quickly scan over the material at the last minute prior to exams. A simple solution for this is to develop series of online discussion questions or short quizzes that follow the lecture material, thereby breaking up the larger assessments into smaller ones spread out during the semester. The lack of an attendance requirement for online students had the disadvantage of allowing a student to become disengaged from the learning environment compared to a traditional classroom environment where attendance was mandatory. Less disciplined

students can find themselves falling too far behind in online course materials to do well on the exams, although we did not observe reduced exam grades for online students in this study. The lack of face-to-face interaction in distance education courses may cause learners to feel isolated, frustrated with technology, thus losing interest in the subject and eventually dropping the class (Day et al., 2005; Fulford and Zhang, 1993). The instructor also noted that online students would quickly get more frustrated if he did not respond to their emails immediately compared to the classroom based students. Providing prompt feedback to student performance, using a variety of assessments to realistically evaluate student learning, offering learning guidance, and providing stimulating material were identified to be successful distance education teaching strategies from experiences of a variety of agricultural educators (Miller and Powell, 1998).

Summary

Online education provides a tool to help meet the increasing demand for distance education in a variety of disciplines. With increasing accessibility of technologies to facilitate this type of education, there is considerable demand and movement for colleges of agriculture to develop online courses and programs. Although not all agricultural topics are perceived as appropriate for delivery through distance education, especially those that require hands-on activities (Miller and Miller, 2000), there is a great potential yet untapped for offering a wide diversity of agricultural-related courses online to accommodate the various learning styles, educational goals, and accessibility issues of the individual leaner (Miller, 1997). Findings from this study suggest that online education can be as instructively effective as a traditional classroom-based delivery system for an introductory turfgrass management course, even despite the lack of student familiarity with online learning and experiences with the internet during the time of this study. To effectively evaluate online distance learning, it is essential to examine student performance together with student satisfaction. The evaluation model and statistical design that incorporates both student performance and satisfaction used in this study may be generalized to conduct similar comparisons between online and classroom-based courses from a variety of disciplines.

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