Achievement predictors for a computer-applications module delivered online

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Abstract

The program evaluation compared student achievement and self-report data in two types of learning environments—a traditional classroom environment and an online learning environment to examine the comparative effectiveness of online delivery, to identify characteristics of successful and unsuccessful distance learning students, and to gauge degree of satisfaction with online delivery. Undergraduate students (N=93) enrolled in four sections of Business 100, Computer Fundamentals, were assigned by section to complete a 4-weeks long spreadsheet module either in class (control) or online (experimental). The online instruction was delivered via a website and was supplemented with e-mail and listserv discussion. Posttest findings revealed no significant differences in knowledge gain between the control (M = .75) and online (M = .77) groups, indicating that this online module was at least as effective as the traditional classroom instruction. Post hoc analysis of achievement data showed that more capable students working online scored significantly better ($p<.01$) than the more capable control group. Self-report measures compared to achievement indicated that frequent computer users benefited most from online delivery, while frequent computer use was not a factor in the control group's performance. Also competitiveness had a negative correlation with achievement for the online group but not for the control group. In summary, this online instruction provided an effective standardized course delivery. However low-prior knowledge students who are less frequent computer users were not served well by this online instruction.

Keywords: online learning, computer fundamentals, performance predictors, spreadsheet instruction, distance learning

1. INTRODUCTION

This program evaluation considered the effectiveness of online delivery of an instructional module of an existing course, Business 100, Computer Fundamentals, compared to traditional classroom instruction. The study was designed to determine whether this online instruction is as effective as the traditional classroom, to describe the characteristics of successful and unsuccessful distance learning students, and to gauge the degree of satisfaction with online delivery (Carlton, Ryan, & Siktberg, 1998; Fulkerth,1997; Moore & Thompson, 1990; Suter & Perry,1997; Verduin & Clark, 1991).

A primary reason for this program evaluation is that approximately twenty sections of this course are offered per academic year. The large number of sections offered and lack of funding for additional full-time faculty necessitates the use of a high proportion of adjunct faculty. For many reasons such as high

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instructor turn-over, no office hours, little time, and lack of infrastructure, the content and quality of the course when taught by adjuncts may not always match the standards set by full-time faculty. Converting a classroom course to online delivery can standardize course content and methods (Fulkerth,1997), thus mitigating instructor effects by providing a more consistent experience across the many sections of the course.

2. METHODOLOGY

Design and Sample

This study used a posttest only design with one experimental treatment and a control group, and also correlation analysis of achievement and self-report measures. The dependent variables included students' achievement on a spreadsheet application test and students' self-report on a distance learning survey and a satisfaction survey.

The potential sample for this study consisted of all students enrolled in Business 100, Computer Fundamentals, in The School of Business at the College of New Jersey in the Spring of 1999. During a typical academic year, approximately 20 sections of Computer Fundamentals averaging about 10 sections per semester with 25 students per section are offered.

Four sections of Computer Fundamentals, consisting of 93 students were selected as the sample for this research study. To assure uniformity in research procedures, the same instructor was assigned to teach all four sections. Two sections consisting of 48 students were randomly selected as the traditional instruction group (control). The remaining two sections consisting of 45 students were identified as the experimental (online) instruction group. A pretest on course concepts revealed that none of the students had a mastery level sufficient to pass the spreadsheet posttest.

Besides freshman business majors, many students from all disciplines within the college enroll in Computer Fundamentals to enhance their computer literacy. Although experience with personal computers is increasing, this freshman population consists of students holding very diverse levels of computer literacy. In addition, students vary in ability, motivation, and independence. With this diversity, teaching this lab-based hands-on course has become increasingly more difficult for faculty and more frustrating for students.

Online Course and Procedure

Business 100, Computer Fundamentals, is the first computer course in the School of Business that students are advised to complete in their freshman year. This course covers the fundamental concepts and uses of a computer system. A portion of this course was chosen for online delivery for a number of reasons including institutional need, the availability of multiple sections, and most importantly, the nature of the course and the ability to quantify differences in knowledge and skill. This course is divided into three units of instruction: an introduction to the Windows operating environment, the use of electronic communications, and financial applications using a spreadsheet software package (Microsoft Excel 97). The four-week long spreadsheet unit was selected for conversion to online delivery. The McGraw-Hill Learning Architecture (MHLA) web-based delivery system, which is the online complement to the course textbook, was selected and then adapted to deliver this unit.

Both traditional and online instruction groups completed the first four weeks of the semester in a traditional learning environment, which consisted of students attending both lecture and computer lab classes. Prior to starting the spreadsheet module, students in the online sections were introduced in class to the online unit and given a demonstration of the online software.

Following a description of the research study, students in the online group were asked to participate in the study. Students were informed that their participation was entirely voluntary. Any students that did not want to participate in the study were allowed to attend any of the other 8 regular sections for the 4-week period of the study. All students in the online sections opted to participate in the study.

Students enrolled in the online sections received the URL address of the website that they could access from any computer at any time of the day or night. To facilitate this process, the online students were issued an individual user ID and password to login to the website. Students in the online group read course materials, reviewed class announcements, sent and received e-mail, and completed the assignments at their own pace and convenience. Students in the control group worked on the module systematically during eight regularly scheduled lab and classroom meetings. The course instructor was there to instruct and assist.

The content provided by the MHLA website was identical to the textbook content used by the traditional sections. In addition, all course class work and homework assignments were identical. The difference between treatments involved the delivery mode of instruction, including location, time-of-day flexibility, and group interaction options, and the physical presence of the learners and instructor.

Posttest and Self-report Instruments

During the first session, all participants (control and online) completed the Distance Learning Profiler (DLP, Clariana & Moller, 1999; Wallace, 1999). The DLP consists of 20 statements that have been shown to relate to distance learning course performance for graduate-level students. The DLP consists of four categories (factors) including: Active Engagement, Independence, Competitiveness, and Perceived Course Quality. Because computers and software were both the content as well as the mode of instruction, four questions were added to the DLP to determine the frequency of interaction these students have had with computers.

After four weeks, both control and online students met during their regularly scheduled class period and

completed the spreadsheet applications test in the computer lab under the supervision of the instructor. This test measured the students' ability to perform the concepts included in the spreadsheet module. The spreadsheet applications test included problems on automobile financing, payroll, and statistical functions. The test was given under timed conditions that were uniform for both control and experimental groups. The applications test was the standard measure of assessment used for this module in the past, and it provided a measure of the effectiveness of the two delivery systems. The applications tests for both control and experimental groups were marked by the instructor/researcher using the standard course marking scheme. Total test points were equal to 100.

After completing the applications test, online students also completed an online evaluation form. This 20-item survey was designed to measure students' satisfaction with the online course.

3. RESULTS

Student Achievement Comparisons

An analysis of variance (ANOVA) was computed to compare the spreadsheet applications test means of the groups. The ANOVA obtained an $F(1,91) = 0.54$; MSE = 331.59; $p = 0.46$; which indicates no difference statistically between the scores of the control control group ($X = 75$) when compared to the scores of the online group ($X = 77$).

However, differences were observed for the minimum scores between groups as well as in the median, mode, and standard deviations for the online group compared to the control (see Table 1). These measures of central tendency and the frequency histogram (see Figure 1) indicate that the control group scores were relatively normally distributed, while the online group scores had more low scores while also being skewed towards higher scores.

Table 1. Comparisons of the spreadsheet application test data for the online and control groups.

Statistical Measure	Control	Online
Group Size (N)	48	45
Mean Score (s.d.)	75 (15.9)	77 (20.4)
Median Score	76	83
Mode	64	100
Minimum Score	41	22
Maximum Score	100	100

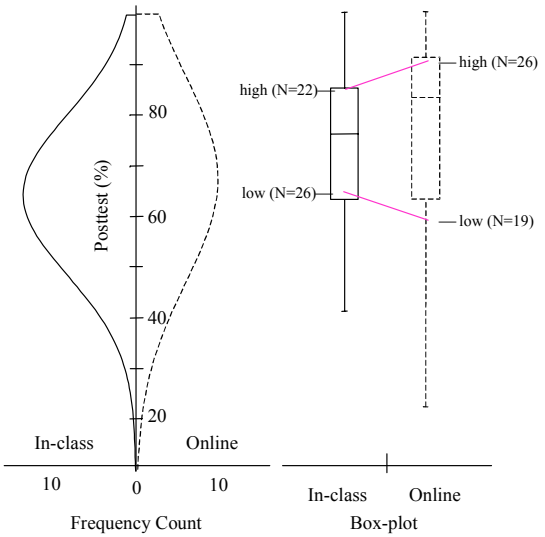

Figure 1. Frequency histograms and box-plots of the spreadsheet applications posttest scores for the control (solid line) and online (dashed line) groups.

Post hoc analysis of posttest data indicates that the differences in central tendency for the online group relate to the general capability of the learner (Bartels, 1982). Specifically, a follow-up 2x2 ANOVA with the factor treatment (Online and Control) and a second factor capability (coded low or high by mean split based on performance on the comprehensive final exam) obtained a significant interaction of treatment and ability, $F(1,89) = 7.78$; MSE = 182.49; $p = 0.006$ (see Figure 1 Box-plots). Follow-up tests suggest that the high-capability students did better than expected on the online instruction (0.33 effect size compared to the control high-capability group, significant at $p<.01$), while low-capability students did not do well with the online instruction (-.38 effect size compared to the low-capability control group, not significant). This interaction could be important since ability relates to factors that have been shown to positively influence success in distance learning including: persistence, desire to succeed, belief they will succeed, independence, high literacy, good time-management skills, and prepared to learn (Phipps & Merisotis, 1999). Note that this finding should not be over-applied, but any capability by delivery mode interaction with online delivery should be considered in future distance-learning research.

After examining the literature, we note that attrition in online classes often runs 10-15% greater than in comparable face-to-face courses (Carr, 2000). Though there was no attrition in this investigation, students that are "low-capable" would be more likely to perform poorly and then drop-out of online instruction as they fell further behind with each assignment. Comparisons of online and face-to-face learning must describe student

attrition, which may tend to inflate the online group's mean (as is likely in MacFarland, 1998).

Distance Learning Profile Predictors

The Distance Learning Profiler (see Table 2) data for the control group were compared to the online group's data. Based on mean differences significant at the $p<.05$ level, the online group (relative to the control) perceived the course as useful (Q4) and appropriate (Q7), and neither boring (Q10) nor exciting (Q20). The online group also reported that they preferred challenges (Q3), thought their views contributed to the quality of the course (Q12), were competitive (Q18), and did not want as much feedback (Q11). Noting that the DLP was given just prior to the start of the spreadsheet module, selection for participation in the online treatment likely established positive expectations about the online course, a "novelty effect".

Table 2. DLP questions. Online minus Control mean shown in parentheses (when significant at $p<.05$).

1. Course assignments are interesting.*
2. I learn best without supervision.*
3. I prefer tough courses that really challenge me. (1.1)
4. Many of the course activities seem useless. (- 1.1)
5. I am a self-starter.*
6. I always try to out perform other students.*
7. The course assignments are appropriate. (0.6)
8. I usually prepare for exams well in advance.*
9. I make sure that other students get my viewpoint.*
10. The course is boring. (-0.7)
11. I prefer constant feedback from the teacher. (-0.7)
12. My views contribute little to the quality of a course. (–1.1)
13. I work harder than others to stand out from the crowd.*
14. I don't care how others are doing on assignments.*
15. I work best under a deadline.*
16. This course actively engages me.*
17. Overall, I consider this to be a high quality course.*
18. I am usually competitive. (0.7)
19. I prefer to do assignments my way.*
20. This course "turns me on"! (-0.9)
21. I use computers everyday.*
22. I often use the Internet.*
23. I don't like computers.*
24. I often access my e-mail.*

* Not significantly different. Scale from 1 low to 7 high.

Next, simple correlation ($p<.05$) between DLP items and spreadsheet applications posttest scores indicates that the students in the control group that describe themselves as working hard to stand out (Q13, $r=.44$), as self-starters (Q5, $r=.39$), and as preferring tough courses (Q3, $r=.29$) performed better on the spreadsheet applications test compared to the other students in the control group. However, these three items did not relate to achievement for the online group.

For online students, not being competitive (Q18, $r=-.35$) and frequent e-mail use (Q24, $r=.32$) most correlated with achievement. Perhaps non-competitiveness relates to a willingness to seek and/or provide help, rather than climb over the backs of others. E-mail use probably relates to both comfort with online instruction and possibly increased time with the online materials. These two were related to achievement for the online group but not for the control group.

Online Satisfaction Scores

Student satisfaction with the online portion of the course is an important consideration in the possible widespread adoption of this instructional approach by the institution. A researcher-developed online evaluation form (see Table 3) was given only to the online group at the end of instructional unit. Considering, in order, only those items that received a 75% positive response or better, the online group strongly indicated that they read the class announcements (Q9), forwarded their assignments by e-mail (Q8), used the course as instructed (Q1), and kept up-to-date with the online work (Q2). Item 17 was the only item significantly related to achievement ($r=.37$, $p<.01$). Students that scored well on the spreadsheet applications test indicated that they would like to be part of a future online course.

Table 3. Online evaluation form.

F	Question.
1	1. I used the online course as instructed.
1	2. I stayed up-to-date with my online work.
3	3. I attended the tutorial lab for additional assistance.
1	4. The online course was easy to access.
1	5. I had connection problems with the online course.
1	6. The online course was a positive educational experience.
1	7. The online course was a negative educational experience.
1	8. I used the e-mail function to forward my assignments.
1	9. I read the class announcements/ messages.
1	10. I gave my best effort to the online course.
1	11. I'm a procrastinator and not meant for online courses.
1	12. I stayed in touch with my professor during the online course.
2	13. The online course needed to be more interactive.
2	14. I preferred reading my textbook over the online material.
3	15. I used the quiz feature of the online course.
3	16. I just did the bare minimum on the online course.
2	17. I would like to be part of an online course in the future.
2	18. I liked the features of the online course.
1	19. I procrastinated until the last week when the work was due.
1	20. I would recommend an online course to my friends.

F- Factor.

A principal components factor analysis was conducted on the online groups online evaluation self-report data to further clarify perceptions of the online portion of the course and how these perceptions correlated with performance on the spreadsheet applications test. Three factors were identified (see Table 3 again):

Factor 1 – Kept up and worked hard or not
Factor 2 – Liked/Disliked the online course; and
Factor 3 – Did/Did not use optional support

Factor 2 was the only factor significantly related to achievement and accounted for 16.6% of the variance in the spreadsheet applications test scores ($F(1,40) = 6.526$, $p < 0.01$, $MSE = 296.60$). Apparently, a subset of online students really did not like the online course and also did not do well on the spreadsheet applications test. Though it cannot be concluded that dislike of the online course caused poor performance on the application test, there is some face validity to suggest that students that dislike online learning will under-achieve in an online learning environment. Note that the perception that they worked hard or not; and that they did or did not take advantage of opportunities like the online quizzes and tutorial labs did not significantly impact performance on the spreadsheet applications test.

4. CONCLUSION AND RECOMMENDATIONS

Consistent with previous research (Phipps & Merisotis, 1999), online learning in this investigation was a viable alternative instructional delivery method for presenting computer concepts and applications in a computer fundamentals course. High-capable online students did better online relative to the high-capable control group. Thus high-ability students were well served by this online delivery. However, low-achieving students who do not use computers regularly did not do as well online relative to the low-capable control group. Thus these students were not well served by online learning.

An important variable related to learning effectiveness is student preference of delivery mode. This study indicates that students that "like" online learning score higher that their counterparts that "dislike" online learning. Thus, student preference for mode of learning should be considered. For example, if online delivery becomes the standard delivery format for this course, a few traditional sections should also be offered so that students may choose between the traditional lecture/lab approach and this online learning approach.

5. AUTHOR BIOGRAPHIES

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