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A Longitudinal Pedagogical study of 39 Online and 25 Face-to-Face Sections of Seven Different Graduate Level MIS Courses

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ABSTRACT

This paper reports on a longitudinal pedagogical study of performance and perceptions of 1021 students in 39 online and 25 face-to-face sections of seven different courses taught by six different professors. The differences between the students' perceptions of the quality of the instructors and student performance are statistically significant based on the mode of course delivery. Students rated the quality of instructors in the online courses higher for the duration of the study. Student grade averages are slightly lower in the online courses. For all of the other survey questions dealing with the evaluation of the courses and the instructors, except the question related to motivation, the online classes had a higher proportion of positive opinions than the face-to-face courses but none of them are significantly different.

INTRODUCTION

Distance education has grown significantly over the last few years to the extent that during the Fall of 2002 more than 1.6 million students took at least one online course as a part of their coursework (Allen and Seaman, 2003). In the state of Illinois alone, the enrollment in Internet-based courses grew from 5,887 in the Fall 1999 to 50,125 in the Spring 2003 (Illinois Virtual
Wide acceptance of Internet and Web-based course delivery has resulted in the development and offering of online courses and degree programs in a broad range of subjects and disciplines. The 2003 Alfred P. Sloan Foundation’s survey of Online Learning (Allen and Seaman, 2003) reports that 34 percent of the institutions they surveyed offer at least one complete online degree program. The same survey indicates that about 578,000 students took all of their courses online. This growth phenomenon in online course and degree offering and enrollment have made higher education more easily available and accessible to working individuals with limited available travel time, and to those who live in rural areas and away from educational institutions. The significant growth in the number and diversity of Internet and Web-based course and degree programs makes it necessary to carefully scrutinize and evaluate the quality and effectiveness of online instruction and to identify ways to use technology to improve teaching and learning in both online and face-to-face delivery modes.

The Alfred P. Sloan Foundation’s Sloan Consortium, known as Sloan-C, about 1997 recognized and publicized its Five Pillars (Mayadas, 1997) for high quality online education: learning effectiveness, student satisfaction, faculty satisfaction, cost effectiveness, and access. The focus of this paper is on learning effectiveness and student perception of course quality.

Learning effectiveness of online instruction, in particular, has been compared with the traditional methods of instruction to determine if online learning is effective. A number of studies (Allen and Seaman, 2003; Russel, 2003; Hiltz et al., 2002) support the effectiveness of online learning. A recent survey (Allen and Seaman, 2003) states that: “A majority of academic leaders (57 percent) already believe that the learning outcomes for online education are equal to or superior to those of face-to-face instruction.” More significantly, “…one-third of these same academic leaders expect that learning outcomes for online education will be superior to face-to-face instruction in three years…”

Numerous studies are available (Russell, 2000) which report on assessment of the quality of and satisfaction with distance learning at different levels, in various disciplines, and for different genders. A study conducted by Koch (1998) reports no significant difference for course satisfaction in distance education between male and female students. Based on their study, Schulman and Sims (1999) concluded that students who enroll in online courses are likely to be better prepared for the courses than those who enroll in face-to-face courses. Smeaton and Keogh (1999) did not find any significant difference in learning for undergraduate courses when they used virtual lectures. Goldberg (1997), based on one course he studied, concluded that students who have access to both face-to-face and online instruction realize a higher level of achievement.

Studies of learning style preferences have shown that males and females differ in preferred style (Pettigrew & Zakrjasek, 1984; Lundeberg et al., 1994; Mann, 1994; Dwyer, 1998; Keri. 2002). In general, females tend to be relational learners, while men may be better characterized as independent learners. Mann (1994) investigated the learning conditions confronting women and girls in several subjects. Mann found that they often face learning conditions that include instructor bias, and when institutions promote a competitive or assertive style of learning, they damage the friendship networks that females are more likely to favor than men do. Mann,
therefore, called for teaching techniques that place more emphasis on collaboration and textbooks that depict females as authors and originators of novel scientific discoveries.

Keri (2002) found that males preferred applied learning styles, those in which life experiences are used as a basis for learning. He also found that females preferred relational and abstract learning styles that included reading assignments, organized learning materials, and demonstration of knowledge by instructors.

Most studies of online teaching and learning to date have focused on a single course or subject taught by an individual professor. The purpose of this paper is to report on a five and a half-year longitudinal pedagogical study of performance and perceptions of 1021 students in 39 online and 25 face-to-face sections of seven different courses taught by six different professors. A universal end-of-semester student course evaluation is used to compare the online and face-to-face course pedagogies. The enrollment pattern based on gender in the online and face-to-face course is studied. The performance of students in the online and face-to-face courses is also compared.

**BACKGROUND**

One way to measure learning effectiveness is by looking at the grades students receive in a course. Another approach is to survey the students regarding their perception of learning the course content and their satisfaction with the course and the instructor. Both of these assessment approaches are used in this study to compare effectiveness of online and face-to-face courses. The data here are used to report on the performance and perceptions of 1021 students in 39 sections of online and 25 sections of face-to-face courses in seven different courses taught by six different professors from the Spring of 1998 through the Summer of 2003. The data were collected using a universal end-of-semester student course evaluation used on this campus. The same evaluation form was used to develop and test the following hypotheses. Our aim is to compare the performance of students and assess the students’ perceptions of course quality in online and face-to-face courses to evaluate effectiveness of online course delivery. The gender-based enrolment pattern in the online and face-to-face courses is also studied.

Hypothesis 1: There is no difference in gender distributions in the online and face-to-face courses.

Hypothesis 2: There is no difference in distribution of grade expectations between the online and face-to-face courses.

Hypothesis 3: There is no difference in the distribution of reasons for taking the course between the online and face-to-face courses.

Hypothesis 4: There is no difference in the distribution of change of interest in the subject between the online and face-to-face courses.

Hypothesis 5: There is no difference in the distribution of increase in critical thinking skills between the online and face-to-face courses.
Hypothesis 6: There is no difference between the online and face-to-face courses in the distribution of students' opinions about whether the instructor's presentation is well planned and organized.

Hypothesis 7: There is no difference between the online and face-to-face courses in the distribution of students' opinions about the instructor's competency in the subject matter.

Hypothesis 8: There is no difference between the online and face-to-face courses in the distribution of students' motivation to work at the highest level in the courses.

Hypothesis 9: There is no difference between the online and face-to-face courses in the distribution of students' opinions about the overall quality of the instructor.

Hypothesis 10: There is no difference between the online and face-to-face courses in the average course grade.

The courses analyzed in this study were all graduate level MIS courses including technical foundations of information systems, management information systems, strategic decision support systems, management of database systems, systems analysis and design, telecommunications, and electronic commerce.

For most semesters, one section of each course was offered using the traditional face-to-face delivery mode, and the other was offered as a fully online section delivered via the Internet. For some semesters, the online and face-to-face courses were offered on a rotation basis. Each professor had full control of the course content, which (s)he had developed over a period of two previous semesters. The same textbook and instructional materials were used for both sections of each course.

The online section of each course was offered using interactive courseware made available via the World Wide Web. The courseware contained lecture notes; PowerPoint slides; lecture outlines; online papers and cases; links to various related sites; self-grading, randomly generated online quizzes; some audio files; and conferencing tools for synchronous and asynchronous class discussions. A different conferencing board was used for online and face-to-face sections of the courses. In both modes of delivery students had access to the interactive courseware.

For all of the online and some of the face-to-face sections of these courses, students were required to submit their assignments electronically and/or post them on the Web. With the exception of exams, for most of these courses no print or paper-based assignments were used. E-mail, listserv, and conferencing tools were used extensively to facilitate interaction among the students and between the students and the professors in both online and face-to-face sections. However, reliance on these tools for instruction in the online sections was much higher than in the face-to-face sections.
Enrollment in each of the sections of the courses was between 5 and 27 students. This relatively low enrollment allowed for a significant amount of interaction between the professor and students and among the students.

An identical and anonymous end-of-semester course evaluation was used to evaluate both the online and face-to-face courses. The purpose of the course evaluations was to assess the students' overall satisfaction with the courses. The objective of our analysis was to determine whether there were any statistically significant differences in students' opinions about the courses' pedagogy, and between the students' performance in these courses based on the mode of course delivery.

**METHODOLOGY**

The instrument used was an end-of-semester course evaluation normally used in all courses offered on this campus (Appendix A). It is a short survey, consisting of three parts. The first part is related to the respondent's background information and demographics. The second part includes questions related to the assessment of the course. The third part contains questions related to the evaluation of the course instructor. The instrument consists of ten close-ended questions. A five-level Likert scale is used to determine the level of agreement with the stated assertions for some of the questions; "yes," "no," and "no response" are the options for the others.

The subjects in the study were the 1021 students who took the courses. However, only 850 students completed the end-of-semester course evaluation forms. Of those students who completed the evaluation form, there were 519 male (61%) and 328 female (39%) students (3 students did not respond to the question related to gender). There were 680 students in the 39 online and 341 students in the 25 face-to-face sections of the courses. From the evaluation forms, we find that there were 215 female students in the online classes and 113 female students in the on-campus classes. There were 312 male students in the online classes and 207 male students in the on-campus classes.

To evaluate any possible difference between the students' performance in the online and face-to-face courses, the semester grades of the students were analyzed. The semester grades for the 39 online courses were combined and grades for the 25 face-to-face courses were combined. Analysis of variance was conducted using course grade as the dependent variable and course and mode of delivery as factors.

**DATA ANALYSIS AND FINDINGS**

For the purpose of this study, the data from the 39 online courses were combined, as were the data from the 25 face-to-face courses. Data analysis was done on the demographic information as well as the other questions to determine the level of the respondents' agreement with or perception of specific assertions. The instrument consists of the following ten questions (Q1 to Q10):
Q1) Class standing (undergraduate, graduate, and no response)

Q2) Gender (female, male, and no response)

Q3) Grade expectation for the course (A, B, C, D, etc.)

Q4) Main reason for taking the course (elective, degree requirement, and no response)

Q5) Change of interest in the subject (increased, remained about the same, decreased, and no response)

Q6) Increase in critical thinking skills (yes, no, and no response)

Q7) Instructor's presentation is well planned and organized (yes, no, and no response)

Q8) Instructor's competency in the subject matter (five-level scale from exceptionally competent to incompetent)

Q9) Motivation to work at the highest level in the course (yes, no, and no response)

Q10) Overall quality of the instructor (five-level scale from excellent to poor)

Regression analysis for both online and face-to-face courses was used to test for significance of changes over time. Analysis of variance was used to compare the two delivery modes.

For question one no statistical analysis was done based on class standing since 98% of the students in the classes were graduate students.

For question two regarding gender, the data analysis suggests that there is no significant difference (P-value = 0.0552) between the average proportions of female students in online and face-to-face courses. Over time, the proportion of female students decreased for both online and face-to-face courses and the proportion of female students in the face-to-face courses decreased faster than in the online courses (Figure 1).

For question three, grade expectation, there is no significant evidence (P-value = 0.3629) to indicate that the grade expectation is different between the online and face-to-face sections of the courses. In other words, course delivery mode does not affect students' grade expectations.
For question four, main reason for taking the course, there is no significant evidence (P-value = 0.5808) to suggest that the distribution of students taking the courses as electives or as degree requirements is different between the online and face-to-face sections of the courses.

For question five, change of interest in the subject, there is no significant evidence (P-value = 0.8114) to suggest that the distribution of change of interest in the subject depends on the mode of course delivery. The same is true when we looked at this question over time. Figure 2 shows the five and a half-year pattern.
For question six, regarding the increase of skills in critical thinking, there was no significant evidence (P-value = 0.5694) to indicate that the mode of course delivery has any impact on students' perception of their ability to develop their skills in critical thinking. In other words, the students' ability to develop critical thinking skills in the subject areas did not depend on the mode of course delivery. The same is true when we looked at this question over time (Figure 3).

![Figure 3: Percentage of Students Agreeing the Course Increased their Skills in Critical Thinking](image)

For question seven, regarding the instructor's presentation and the degree to which the course was well planned and organized, there was no significant evidence (P-value = 0.7861) to suggest that the distribution of students' opinions depended on the mode of course delivery. The same is true over time. Figure 4 shows the five and a half-year pattern.

![Figure 4: Percentage of Students Agreeing the Course is Well-planned and Organized](image)
It is interesting to note that, while not significantly different, the above pattern shows that students in the traditional classes responded more positively to the question dealing with how well the courses are planned and organized over the last few years of the study. This could be due to the fact that the online course materials, which are generally more organized, were made available to the traditional students as well.

For question eight, the instructor's competency in the subject matter, there was no significant evidence (P-value = 0.9910) to suggest that the distribution of students' opinions about the instructor's competency depended on the mode of course delivery. However, there is a significant difference over the study period between the online and the face-to-face courses. The online courses are stable in the evaluation of the competency in the course content. The face-to-face courses are slowly increasing on the evaluation of the competency question (Figure 5).

![Figure 5: Instructors' Competency](image)

For question nine, motivation of students, there was no significant evidence (P-value = 0.8332) to indicate that a course's mode of delivery had any impact on the ability of the instructor to motivate students.

For question ten, there is a significant difference (P-value = 0.0424), between the averages of the evaluation of the overall quality of the instructors in the online (4.6393±0.0384) and in the face-to-face (4.5±0.0567) courses. There is also a significant difference over time between the online and face-to-face courses. Face-to-face courses are stable on the evaluation of the overall quality of the instructors. Online courses slowly decreased for a period of a few years and then slowly increased. This may be explained by the fact that faculty are gaining experience in teaching online courses over time as well as improvements made in the technology and infrastructure used to deliver the online courses (Figure 6).
The semester grades for the 39 online courses were combined, as were those of the 25 face-to-face courses. There is a significant difference (P-value = 0.0015) between the average grade received in online (3.3595±0.0284) and face-to-face (3.488±0.030) courses. There is also a significant difference over time between online and face-to-face courses. Face-to-face courses are stable regarding students’ performance in the courses we analyzed. Performance of students in the online courses slowly decreased for a period of three years and then slowly increased (Figure 7).

The change in performance of students in the face-to-face courses is not statistically significant. However, the change in performance of the students in the online courses is statistically
significant. Various factors could have contributed to this event. A possible factor is that over the last five and a half-year period a number of new faculty members have been hired. These faculty members enroll in a number of courses specifically developed for online instruction. One can argue that, over the five and a half-year period, faculty gained more experience in teaching online courses. Another factor could be the fact that over the past few years students gained experience in taking online courses and now perform better in these courses. As the pattern indicates, the performance of students in the online courses has been moving upwards over the last five semesters.

Analysis of variance was conducted with course and mode of delivery as factors. The result indicated that both mode of delivery (P-value = 0.0036) and course (P-value = 0.0098) are significant factors accounting for the variation of course grade (Table 1).

<table>
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<th>DF</th>
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<th>MS</th>
<th>F</th>
<th>P-value</th>
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<td>480.525</td>
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</tr>
</tbody>
</table>

Table 1: ANOVA Table

Individual course analysis shows that there is no significant difference in the average course grade between online and face-to-face delivery for six of the seven courses. However, for the Strategic Decision Support Systems course, we find that there is a significant difference (P-value = 0.0228) in the average of course grades between the online (3.495± 0.0379) and the face-to-face courses (3.640± 0.0512). The results indicate that the students in traditional face-to-face sections of the course have a significantly higher course grade average (or better performance) than those in the online sections.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Statistical analysis of the data collected for this study reveals that, under the conditions stated in the background section of this paper, the pedagogy that can be maintained in online instruction is at least as good as what can be achieved with face-to-face instruction. Based on the data, there was no significant evidence to indicate that students' evaluations of the online course pedagogy were any lower than those of the face-to-face pedagogy. For one of the courses in this study, the analysis indicates that when in-class students are given access to the instructional materials available to online students in addition to face-to-face instruction, their performance may be significantly higher than that of the students in the online classes. Goldberg (1997) came to the
same conclusion based on performance of students in an operating systems class. This may imply that students learn better if they have access to both face-to-face and online instruction, as the students in this course did. Developing quality online courses to increase access to higher education for place-bound learners is obviously important. One could also argue that improving face-to-face learning via online instruction is an important side benefit of online instruction.

The students' perceptions regarding quality were better for the online compared with the face-to-face courses. However, the difference was not significant. These perceptions could be due to the fact that the online student body has more experience with online courses, and as such, more appreciation for the content and quality. It could also be the case that online courses require tighter organization and planning than face-to-face courses do, leading to a higher quality product.

Our study and others have reported a higher proportion of female enrolment in online classes than in traditional courses. Although in our study the difference was not significant. Since females tend to have different learning style preferences than men, as the literature indicates, care should be taken in designing online courses to incorporate diverse materials and types of assignments so that men and women have learning experiences that put no undue burden on either gender.

For some learners, learning emerges through interaction with other students. For these learners, the instructor's role is to facilitate interactions among class members instead of controlling the content and the delivery process. As Mitchel Resnick of MIT Media Lab stated in The Internet and the University (2002), we need to reorganize our classrooms – “Instead of a centralized-control model (with one teacher delivering information to a roomful of students), we should use a more entrepreneurial approach to learning. Students can become more active and independent learners, with the teacher serving as a consultant, not as a chief executive.” The online mode of delivery fits well with this model of instruction.

Some learners may prefer individualized instruction. Various Web-based technologies, such as conferencing tools, support this type of learning style. The ultimate goal should be to provide quality education regardless of the type of technology used in teaching and learning and the learning style of the learners or the mode of course delivery.

The time has come to go beyond “The No Significant Difference Phenomenon” (Russel, 2003). We need to identify ways that technologies and resources used for online instruction can also be incorporated in the face-to-face instruction to improve that mode of course and program development and delivery. As Clark points out (Clark, 1983) it is instruction and its quality that make a difference in learning, not what technology is used to do the instruction. We need to leverage the technology to improve teaching and learning. In particular, for online instruction, it is interaction with the instructor, peers, and course content (More, 1989) combined with social presence (Swan, 2002) that have significant impact on the quality of the instruction.

A limitation of our study is the disparity between course evaluations completed and enrollments in all sections of the courses. A higher response rate may have changed the results reported here although we believe not in significant ways.
For this study, we did not ask students whether they had previously taken an online or a face-to-face course and look at whether that had any impact on their selection of an online or a face-to-face course. We also did not attempt to randomly select students for the online and face-to-face courses. The students decided, on their own, which course section to enroll in. Future studies could include a group of students who have primarily negative and a group of students who have primarily positive opinions about the use of the Internet and the Web for course delivery. These students can then be randomly assigned, if they are willing, to online and face-to-face sections of courses taught by the same professor. This approach may further help to assess and compare the pedagogy of online and face-to-face instruction, and may lead to more information about students’ performance in online versus face-to-face courses.

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APPENDIX A

UIS Faculty and Course Evaluation

Course Title: ___________________________ Course Number: ___________________________

Instructor’s Name: ___________________________ Semester: ___________________________

If this course is team taught, a separate evaluation form must be filled out for each instructor.

Please mark your response in the space provided to the left of the questions.

1. Your current class standing:
   (1) undergraduate (2) graduate

2. Your sex:
   (1) female (2) male

3. Grade you expect to receive in this class
   (1) A (2) B (3) C (4) D (5) U (6) I (7) CR (8) NC

4. I took this course as:
   (1) an elective (2) a program requirement

5. As a result of taking this course, my interest in this subject has:
   (1) decreased (2) remained the same (3) increased

6. This course has increased my skills in critical thinking:
   (1) yes (2) no

7. The instructor’s presentation is well planned and organized:
   (1) yes (2) no

8. Do you think this teacher is competent in the content or material offered in this course?
   (1) Incompetent (2) (3) Satisfactory (4) (5) Exceptionally Competent

9. This course has motivated me to work at my highest level:
   (1) yes (2) no

10. Overall, how do you rate the quality of this person as a teacher?
    (1) poor (2) fair (3) good (4) very good (5) excellent

If you believe that you have experience any disadvantages during this course
Because of your sex or racial or ethnic background, you should contact
The Associate Chancellor for Affirmative Action.