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Is Face-to-Face Better than Online? A Five-Year Longitudinal Study of 33 Online and 25 Face-to-Face Sections of Seven Different Courses

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IS FACE-TO-FACE BETTER THAN ONLINE? A FIVE-YEAR LONGITUDINAL STUDY OF 33 ONLINE AND 25 FACE-TO-FACE SECTIONS OF SEVEN DIFFERENT COURSES

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Abstract

The number and diversity of online programs offered by many institutions has significantly increased over the last few years. Along with this increase have come both support and critics of the quality and effectiveness of online instruction. The purpose of this paper is to report on a five-year longitudinal study of performance and perceptions of 902 students in 33 online and 25 face-to-face sections of seven different courses taught by five different professors. Analysis of data collected for this study shows that the percentage of female students enrolled in the online curses was significantly higher than the percentage of females enrolled in traditional courses. No significant difference was found in the students' perception of the quality of the course pedagogy based on the mode of course delivery. This study supports the finding (Goldberg, 1997), based on a single course he studied, that students in two of the seven courses we studied, who had access to both face-to-face and online instruction achieved a higher level of performance. For all of our survey questions dealing with the evaluation of the course and the instructor, the online classes had a higher proportion of positive opinions than the face-to-face courses but none of them are significantly different.

Keywords: Technology-supported teaching and learning, Web-based teaching and learning, comparison of online and face-to-face pedagogy

Introduction

Distance education has evolved over the years (Abernathy, 1998; Confessore, 1999) and now includes the use of the Internet and the Web. 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. This phenomenon has 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. In the state of Illinois alone, the enrollment in Internet-based courses grew from 5,887 in fall 1999 to 40,550 in fall 2002 (Illinois Virtual Campus Web site). 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.

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. Other aspects of quality online instruction are briefly reviewed.

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 (Russel, 2003; Hiltz et al., 2002) support the effectiveness of online learning. In particular, increasing various types of interactivity and incorporating social presence (Swan, 2002) within the online courses facilitate learning. Some studies (Goldberg, 1997) suggest that students who have access to both face-to-face and online instruction achieve a higher level of performance.

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.

Sachs and Hale (2002) identified online student support services such as academic advising, digital library access, registration, and career services among the important factors that enhance student satisfaction with their online educational experience. Shea et al. (2002) identified factors that increase student satisfaction: student interaction with faculty and its quality, interaction with fellow students and its quality, promptness of feedback, and clear expectations. Swan (2002) identified various types of interaction and incorporation of social presence within the design of online courses as factors that enhance student satisfaction. Trippe (2002) identified more basic factors such as convenience, friendly instructors, emphasis on learning, regular and prompt instructor feedback, and availability of financial aid among student satisfaction factors.

Shea et al. (2002) link faculty satisfaction to availability of technical support and training for online course development and delivery, better student performance, frequent interaction with students, scheduling flexibility, getting to know students better, better course design and assessment, and better ability to measure learning. Some concerns still cited (Shea et al., 2002) include the level and availability of the required technology on the learner side, the ability to verify authenticity of work done and submitted by the students, assurance of quality and learning, and an appropriate approach to guide students into face-to-face instruction when their learning style does not fit with the online mode of delivery.

Bishop and SchWeber (2002) identified indicators of student and faculty support, namely curriculum development and delivery, and evaluation and assessment, and linked the cost associated with these to their low, moderate, and high impact on online course quality. To improve cost effectiveness, Campbell (2002) suggested lowering fixed and variable costs by providing tutorials using simulation techniques and information agents (Thaiupathump et al., 1999) to increase the productivity of faculty, and increasing the student per faculty ratio in online courses. To improve cost effectiveness of online instruction, Estabrook (2002) suggests offering online programs as a part of existing on-campus programs and reserving a number of seats in each online class for out-of-state students who are normally paying higher tuition and fees.

McGrath et al. (2002) identified a number of administrative, instructional, and counseling services that students need to have access to so that the online programs can be effective. Administrative services include providing students with appropriate types of readily available information via Web sites and call centers as well as access to registration, bill payment and the bookstore.

Instructional support services include access to a technical help desk and online library resources. Counseling services include pre- and post- admission counseling and career services advising.

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 & Zakrajsek, 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.

The purpose of this paper is to report on a five-year longitudinal study of 902 students in 33 sections of online and 25 sections of face-to-face courses in seven different courses taught by five 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 courses is studied. The performance of students in the online and face-to-face courses is also compared.

Background

The data here are used to report on the performance and perceptions of 902 students in 33 sections of online and 25 sections of face-to-face courses in seven different courses taught by five different professors from the spring of 1998 through the fall of 2002. The data was 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' perception of course quality in online and face-to-face courses to evaluate effectiveness of online course delivery. The gender-based enrollment 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.

From the spring 1998 through the fall 2002 semesters, 33 sections of online and 25 sections of face-to-face graduate level management information systems courses were offered at a campus of a major state university by five different professors. These were seven different 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. However, the same professor taught the online and face-to-face courses. 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. 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 902 students who took the courses. However, only 745 students completed the end-of-semester course evaluation forms. Of those students who completed the evaluation form, there were 447 male (60%) and 295 female (40%) students (3 students did not respond to this question). There were 561 students in the 33 online and 341 students in the 25 face-to-face sections of the courses. From the evaluation forms, we find that there were 182 female students in the online classes and 113 female students in the on-campus classes. There were 240 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 33 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 33 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)

The overall survey responses for the above questions were analyzed to determine whether significant differences existed in the course evaluations based on the delivery mode. The Chi-square test of independence was used for this purpose. For all questions dealing with the evaluation of the course and the instructor, the online classes had a higher proportion of positive opinions than the face-to-face courses but none of them are significantly different. Table 1 shows the p-values, which vary from 0.0312 for question 2 to 0.9152 for question 7. More detailed results follow.

Table 1. Results of Hypotheses Testing: Online versus Face-to-Face Course Evaluations

Question	2	3	4	5	6	7	8	9	10
P-Value	0.0312	0.3211	0.5339	0.3030	0.9034	0.9152	0.5447	0.6584	0.4942

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

For question two regarding gender, the data analysis suggests that a significantly larger proportion (61.69%) of the female students preferred to take online courses, while only 53.69% of the male students took the online courses. There was a statistically significant increasing trend for females enrolled in the online courses, and a statistically significant decreasing trend for females enrolling in the traditional courses. Figure 1 shows the five-year enrollment pattern for female students.
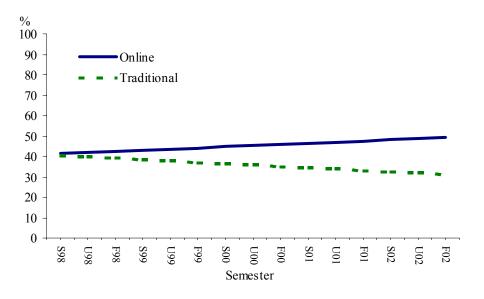

Figure 1. Percentage of Female Students Over the Five-Year Period

For question three, grade expectation, there is no significant evidence 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 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 was no significant evidence to suggest that the distribution of change of interest in the subject depends on the mode of course delivery. Figure 2 shows the five-year pattern.
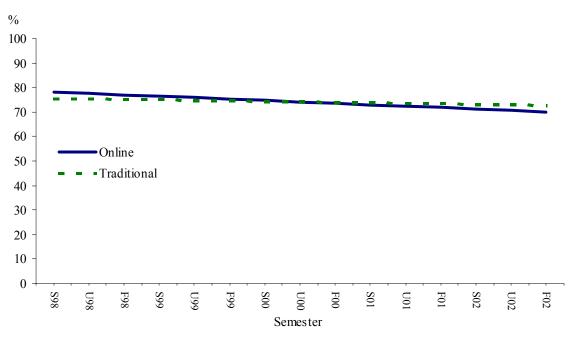

Figure 2. Percentage of Students Indicating Increased Interest in the Subject

The above patterns are not statistically significant.

For question six, regarding the increase of skills in critical thinking, there was no significant evidence 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.

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 to suggest that the distribution of students' opinions depended on the mode of course delivery. Figure 3 shows the five-year pattern.

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 five years. 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 to suggest that the distribution of students' opinions about the instructor's competency depended on the mode of course delivery. Figure 4 shows the five-year pattern.
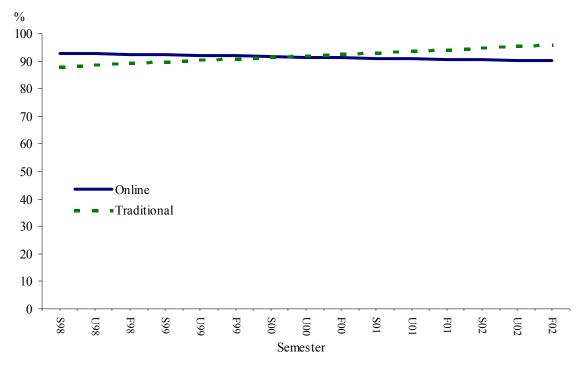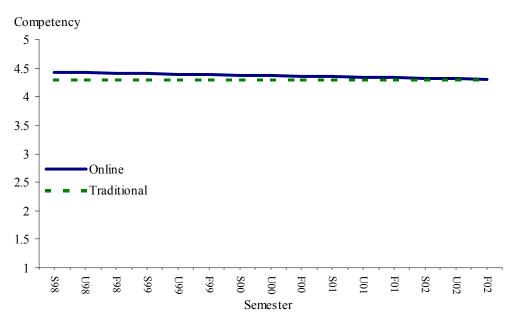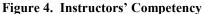
Figure 3. Percentage of Students Agreeing the Course is Well-Planned and Organized

Figure 4. Instructors' Competency

It should be pointed out that the above patterns are not statistically significant.

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

For question ten, the overall quality of the instructor, there was no significant evidence to indicate that the distribution of students' opinions about the overall quality of the instructor was affected by a course's mode of delivery.

The semester grades for the 33 online courses were combined, as were those of the 25 face-to-face courses. The average course grades were 3.54692 ± 0.03 (mean ± standard error) and 3.40784 ± 0.0319 for the face-to-face and online courses, respectively. Analysis of variance was conducted with course and mode of delivery as factors. The result indicated that both mode of delivery ($p = 0.0123$) and course ($p = 0.0001$) are significant factors accounting for the variation of course grade (see Table 2).

Table 2. ANOVA Table

Source	DF	SS	MS	F	P-value
Delivery Mode	1	4.10	4.10	8.86	0.0123
Courses	6	10.03	1.67	3.61	0.0001
Error	894	414.13	0.46		
Corrected Total	901	428.26			

Further analysis shows that there is no significant difference in the average course grade between online and face-to-face delivery for five of the seven courses. However, for the Management Information Systems and Strategic Decision Support Systems courses, we find that there is a significant difference in the average of course grades between the different delivery modes (see Table 3). The results indicate that the students in traditional face-to-face courses have a significantly higher course grade average (or better performance) than those in the online courses.

Table 3. Individual Course Analysis

Course	Delivery Mode	Mean	STD Error	P-value
Management Information Systems	Online	3.2298	0.0837	0.0244
	Face-to-Face	3.4952	0.0817	
Strategic Decision Support Systems	Online	3.495	0.0379	0.0228
	Face-to-Face	3.64	0.0512	

Figure 5 shows the overall performance of students in the online and face-to-face courses over the five-year period. 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 effect. A possible factor is that over the last five years 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-year period, faculty gained more experience in teaching online courses. As the pattern indicates, the performance of students in the online courses has been moving upwards over the last seven semesters.

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 two 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 study 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.
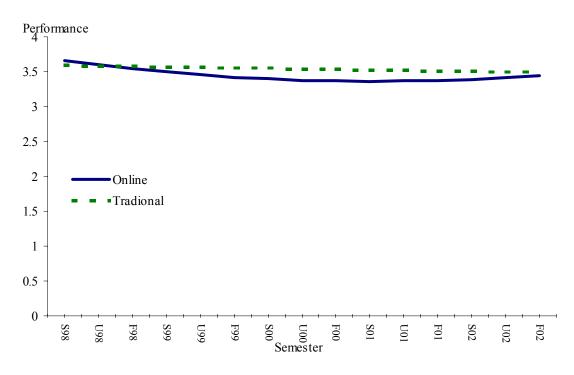
Performance

Figure 5. Students' Performance

The students' perceptions regarding quality were better for the online compared with the face-to-face courses. However, the difference was not significant. This 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.

Our study and others have reported a higher proportion of female enrollment in online classes than in traditional courses. 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.

A limitation of this 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.

This study 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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