Virtual Teaching in Higher Education: The New Intellectual Superhighway or Just Another Traffic Jam?

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Abstract

An experimental design was carried out during the Fall, 1996 in which 33 students in a Social Statistics course at California State University, Northridge were randomly divided into two groups, one taught in a traditional classroom and the other taught virtually on the World Wide Web. Text, lectures and exams were standardized between the conditions. Contrary to the proposed hypotheses, quantitative results demonstrated the virtual class scored an average of 20% higher than the traditional class on both examinations. Further, post-test results indicate the virtual class had significantly higher perceived peer contact, and time spent on class work, but a perception of more flexibility, understanding of the material and greater affect toward math, at semester end, than did the traditional class.

Since 1994, the World Wide Web and related Internet resources (e.g., e-mail, chat, and news groups) have become an increasing viable component in higher education pedagogy. This has led to significant interest in the implementation of Internet based virtual teaching. Yet little, if any, experimental evidence has been generated to demonstrate the effects of virtual versus traditional class format on student performance. What has appeared is largely qualitative or devoid of empirical analysis altogether and argued as simply a remedy or antidote to the deficiencies of the traditional classroom. If quantitative, the data tend to be based on a single class and hence, no experimental comparison, or self selected samples of two or more classes. Considering the amount of money being expended in higher education on infrastructure, software, training and technological pedagogy, this lack of experimental evidence is unconscionable.

An attempt was made to address these deficiencies by engaging in an experimental design in which students from the same class were randomly assigned the first day to either virtual or traditional classroom. These conditions were used to test the effects of face-to-face vs. virtual professor-student interaction, on the test performance of students. The null hypothesis was that face-to-face interaction makes no difference in student test performance. The research hypothesis asserts that it does. In particular, it is argued that such face-to-face interaction with the professor is fundamental to the learning process and that without it students suffer. The parallax view contends that a lack of face-to-face interaction with the professor leads to greater interaction between students and that this collaboration results in higher student test results. The following methodology was implemented to test this consideration.

Methods

Instrument: Subject variation by condition was assessed through the use of a pre-test questionnaire asking, among other things, student demographics and experience with computers, math and statistics. Post-test assessment consisted of student scores on the midterm and final as well as information culled from the post-test questionnaire.

Sample: Student enrollment at California State University, Northridge, Sociology 364, for the Fall of 1996, was increased from the traditional 25 to 40 students to accommodate this experiment. On the first day of class 34 of the pre-enrolled students and three new students attended this once a week Saturday class. This total of 37 students was divided using a systematic random sampling of the enrollment sheet, such that 19 students appeared in the traditional class and 18 appeared in the virtual classroom, initially. Although two students added several weeks into the semester, and were placed in the traditional class, they were not included in the analysis since they were not there for the entire semester (a fact which only would have lowered their condition's average). Moreover, two students from each class failed to complete the semester's work. Therefore, this analysis is based on the remaining 33 students (17 in the traditional class, 16 in the virtual class).

Procedure: The first day of class students were asked to fill out the pre-test questionnaire prior to assignment to conditions. Students were then given a pre-assigned number indicating which room they were to adjourn to. Traditional students were sent to a regular classroom while the virtual students stayed in the lab. Each section was given identical instructions by the instructor as to the scope, content and expectations for their performance in the class.

Subsequently, students in the virtual class were given instructions by the lab assistant on the requisite technology necessary to accomplish the virtual format of instruction. This technology included instruction in accessing e-mail, World Wide Web, mIRC and Hypernews. Additional instruction to facilitate on-line connections was given. To assure student competency, the virtual class met for a second week to review the previous week's instruction, thereby maximizing their ability to carry out the class in the virtual setting.

The traditional class met every Saturday during the next 14 weeks as scheduled from 9:00 am to 1:30 pm.. The virtual class met only twice after the first two weeks--during the 7th and 14th week to take the midterm and final examination. The traditional class solved common weekly problem assignments submitting them in each week. The virtual class had four

assignments each week: 1) e-mail collaboration among randomly assigned groups of three students in which they generated weekly statistical reports and sent them to the instructor using e-mail; 2) hypernews discussion in which a weekly discussion topic was responded to twice a week by each student; 3) forms input via the WWW which allowed for student submission of the same homework problems being solved by the traditional class; and 4) a weekly moderated Internet relay chat (mIRC) in which student discussion and dialogue were carried out in real time in the virtual presence of the professor. Traditional office hours were held for both the virtual and traditional students on Saturday afternoons (separate hours for each section).

Results

Based on the sample conditions, pre-test comparisons were made between these two groups in age, sex, ethnicity, years in school, grade point average, or familiarity with computers and math The results are as follows:

Table I about here

As can be seen from the table, no significant differences appeared in any of the demographic or experiential variables. Students were tested at midterm and final weeks using identical tests for both classes, which were administered at the same time and location. The tests consisted of four parts: 1) matching; 2) objective; 3) definitions; and 4) problems. Results were tallied for each examination by question type. The results are as follows:

Table II about here

Results indicate the virtual students scored an average of 20 points higher on the 100 point midterm and final exams. These results are consistent on both the midterm and final, across all four question types. All differences are highly significant. Further, post-test results were tabulated for both degree of interaction with fellow students, time spent on the class, perceived degree of flexibility and understanding of the material and feelings of affect toward the professor, the class, computers, and math. The results are as follows:

Table III about here

Although ratings on the post-test questionnaire show more marginally significant differences, the data do indicate the virtual students communicated more with fellow students. And, although they perceived they spent significantly more time on class work, they were also more likely to think they had more flexibility, a greater understanding of the material, and more positive affect toward math, in the end, than did the traditional class

Discussion

This experiment was intended to assess the merits of a traditional, versus virtual, classroom environment on student test performance and student affect toward the experience. It was hypothesized that face-to-face professor-student interaction is crucial to test performance. However, the data indicate the reverse, that virtual interaction produces better results.
In an attempt to explain this finding, it is informative to note that the virtual students seemed more frustrated, but not entirely from the technology. Rather, it stemmed from the inability to ask questions of the professor in a face-to-face environment. I believe this lead paradoxically to student compensation evidenced by more involvement between and among peers, who formulated study groups to “pick up the slack of not having a real classroom.” That this collaboration manifests itself in better tests scores is consistent with the findings of the collaborative learning literature. That it is also related to findings of greater perception of flexibility of process is intuitive, given the technology. That it is also related to a better understanding of the class, and, in general, a greater understanding of math, is serendipitous.

Therefore, from these data, I suspect as much of the performance differences can be attributed to student collaboration as to the technology, itself. In fact, the highest performing students (in both classes) reported the most peer interaction. Therefore, it is important that faculty contemplating the use of the virtual format pay attention to the issue of real time collaboration, whether carried from within the traditional classroom or in the context of virtual space. This is the key variable that should be controlled in further research on the subject of virtual teaching.

As a postscript, it is interesting to note there was no consensus as to the effectiveness of the four Internet technologies. Students in the virtual class were randomly distributed in their ratings of the impact of the four techniques. Perhaps further research also should be done to isolate the differential value of each.

TABLE I
Demographics by Condition

VARIABLE	TRADITIONAL	VIRTUAL	SIGNIFICANCE
AGE (Mean Age)	27.4	27.8	NS
SEX (% Female)	56%	66%	NS
ETHNICITY (% Anglo)	44%	47%	NS
YEAR (% Senior)	77%	80%	NS
GPA (Mean GPA)	3.14	3.40	NS
UNITS (Mean # semester)	14.30	13.30	NS
HRS WKD (Mean # / week)	19.30	21.20	NS
DAYS at CSUN (Mean # / week)	3.86	3.40	NS
Computer Feelings (1-10)	6.50	7.40	NS
Math Feelings (1-10)	6.36	6.47	NS
Statistics Feelings (1-10)	6.00	6.93	NS

TABLE II
Examination Results - Mean Scores by Condition

	TRADITIONAL	VIRTUAL	SIGNIFICANCE
MIDTERM (100 pts)			
Matching (of 10)	6.88	8.88	(P<.007)
Objective (of 40)	20.12	28.75	(P<.001)
Definitions (of 15)	8.94	10.75	(P<.050)
Problems (of 35)	18.82	23.75	(P<.030)
TOTAL	54.76	72.31	(P<.001)
FINAL (100 pts)			
Matching (of 10)	7.88	9.13	(P<.100)
Objective (of 40)	23.88	35.63	(P<.001)
Definitions (of 15)	9.00	10.94	(P<.040)
Problems (of 35)	20.59	25.88	(P<.040)
TOTALS	61.35	81.56	(P<.001)
EXAM TOTALS (200 pts)	116.12	153.88	(P<.001)

Table III
Post-test Results

Means Scores by Condition

VARIABLE	TRADITIONAL	VIRTUAL	SIGNIFICANCE
Attitude toward Math	4.76	6.81	(P<.033)
Student Contact	5.17	7.25	(P<.039)
Time Spent on Class	6.94	9.00	(P<.010)
Perception of Flexibility	4.87	6.43	(P<.087)
Understanding of Material	4.76	6.06	(P<.092)