# Assessing the Effectiveness of Virtual Learning in Graduate Course in Computer Information Systems

Amjad Abdullat

Department of Computer Information Systems West Texas A&M University

Canyon, Texas 79016

aabdullat@mail.wtamu.edu


and


Neil Terry

Department of Accounting, Economics and Finance

West Texas A&M University

Canyon, Texas 79016

nterry@mail.wtamu.edu

## Abstract

This paper presents empirical results concerning the effectiveness of campus, online, and hybrid (mix of campus and online) instruction in computer information systems. The sample consists of graduate students enrolled in a core MBA course at a regional university. Assessment of enrollment, attrition, grade distribution, faculty evaluation, and course evaluation across the various instruction modes is presented. Holding constant ability, effort, and demographic considerations, students enrolled in the online course scored over two percent lower on the final exam than campus students and six percent lower than hybrid students. There is not a statistically significant difference between student performance on the final exam between campus and online modes, although the hybrid mode of instructions that combines campus and online is shown to be the most effective mode.

Keyword: on-line education, MBA on-line, MIS, on-line Assessment

### 1.0 INTRODUCTION

There is little doubt that the online mode of instruction has become a major part of higher education and an important strategic issue for business schools. The U.S. Department of Education estimates that 100 new college courses are added to the online format each month (National Center for Education Statistics, 2001). In recent years, the efficacy of online instruction has been debated in the literature, as the mode has become ubiquitous (Lezberg, 1998; Okula, 1999; Terry, 2000). One alternative to online instruction is the hybrid instruction mode. The hybrid mode combines some of the inherent features of the online (e.g., time independence) and campus (e.g., personal interaction) environments. The purpose of this paper is to compare student satisfaction and performance in the campus, online, and hybrid instruction modes in computer information systems courses. Standard assessment and regression techniques are employed. The research is based on a graduate course in computer information systems targeted to Master of Business Administration (MBA) students at a regional university. The paper is organized as follows: First, an overview of concepts and

definitions important to distinguishing the three instruction modes is provided. The next section presents assessment information relating to enrollment, attrition/drop rate, grade distribution, and student evaluation of faculty and course. Third, an empirical model testing the effectiveness of instruction mode while controlling for effort, ability, and demographic considerations is developed and employed. The final section offers conclusions and implications.

## 2.0 BACKGROUND

The fundamental characteristics of the campus, online, and hybrid instruction modes are not universally agreed upon. The authors acknowledge this lack of consensus but offer somewhat generic descriptions of each format in order to facilitate the research process. Campus-based or traditional instruction is probably the easiest to understand. The campus mode is characterized by student/faculty interaction via lectures, discussion, and exams on campus at scheduled times and days. There is approximately forty-five contact hours associated with a three credit hour course in most traditional campus courses. The personal interaction between students and faculty associated with campus courses is often perceived as a characteristic that facilitates high quality learning. In addition, most professors were educated via traditional campus instruction and are familiar with the learning environment from the perspective of student and instructor.

The online mode of instruction replaces the walls of the classroom with a network of computer communication. Some of the benefits of online instruction are its temporal, geographic and platform independence, and its simple, familiar, and consistent interface (Latchman, Salzmann, Gillet, and Kim, 2001). Some of the drawbacks are: sophistication and creativity restricted by hardware and software compatibility; resistance to shift to new and alternative teaching and learning paradigms; privacy, security, copyright, and related issues; and a lack of uniform quality (McCormack and Jones, 1998). Online instruction is heralded for providing flexibility for students in that it reduces the often-substantial transaction and opportunity costs associated with traditional campus offerings. This flexibility in structure is countered by potential problems including lack of personal interaction (Fann and Lewis, 2001), the elimination of a sense of community (James and Voight, 2001), and the perception of lower quality. In addition, faculty often have reservations about preparing a new online course because of the large initial time investment involved, estimated to be at 400-1,000 hours per course (Terry, Owens and Macy, 2000).

Not all students can take campus courses and not all want online instruction. The general problem with campus courses for working professionals is the time constraint, while the most common complaint about online courses is the lack personal interaction between

students and professor that is often needed to facilitate the learning process, especially for advanced coursework. The hybrid mode is a potential solution that combines the positives from both modes. There are approximately eighteen to twenty-five contact hours associated with a three credit hour course. The decreased classroom contact time is offset by computer-based communication that includes lecture notes, assignments, and e-mail correspondence. The hybrid mode allows busy graduate students and working professionals limited in class time, while maintaining an adequate amount of contact time with faculty and peers.

The obvious criticism of the hybrid format is the potential that the instruction mode does not combine the best attributes of the campus and online formats but the worst attributes. The potential negative attributes of hybrid instruction include a feeling that there is an inadequate amount of time to cover lecture topics, double preparations for the instructor because the mode requires both lecture and online materials, and a lack of time and geographic flexibility with respect to the campus lecture component.

Results from this study are derived from 186 MBA students enrolled in a core computer information systems course in the years 2000-2003. The study cohort consists of 72 campus, 69 online, and 45 hybrid students. Every effort was made to keep the content and course requirements consistent across the three instruction modes in order to make multiple comparisons viable. Half the student grade in each course is determined by homework/project assignments and the other half of the grade is determined by a proctored final exam. Twenty of the original 186 students dropped the course without taking the final exam, yielding a final research cohort of 166. Sixty-eight percent of the students in the survey have full-time jobs. Fifty-five percent of the students have at least one child. Sixty-six percent of the sample population is male. Twenty-two percent of the students are foreign nationals. Eighty-two percent of the students in the survey live within a one-hour drive of campus.***---discuss some of the specifics of this CIS course---***

## 3.0 ASSESSMENT RESULTS

Table 1 presents a multiple comparison of instruction modes across the common assessment criteria of enrollment, attrition/drop rate, grade distribution, student evaluation of faculty, and student evaluation of courses. The last three assessment variables are measured on a standard 4.0 scale, where 4.0 is the highest possible grade or score. Statistical differences in means are tested by employing a Kruskal-Wallis test for multiple comparison (Conover, 1980). The Kruskal-Wallis test is employed because it offers the most powerful test statistic in a completely randomized design without assuming a normal distribution. The results indicate average enrollment for the online instruction

mode is significantly greater than the campus or hybrid alternatives. Because students have the option of enrolling in the instruction mode of his/her choice, the enrollment numbers imply the demand for the online mode is relatively high. Average enrollment for the online mode was approximately thirty percent higher than the alternative modes. The results imply the convenience associated with online instruction is attractive to the study cohort.

Attrition/drop is defined in this study as the difference between the number of students officially enrolled in the course on the first class day versus the number officially enrolled on the last class day. The results indicate a clear difference in attrition/drop rates across the instruction modes. The campus attrition rate of 5.55 percent is significantly lower than the online and hybrid rates of 13.04 percent and 15.56 percent, respectively. One possible explanation of this result is that student/faculty personal interaction is an important component in student retention.

The fluidity and independence associated with the online mode might also result in a relative ease of exit. Another possible explanation is that the campus mode has a greater probability of meeting the expectations of students with respect to content and course procedures. Many students have preconceived notions about online (e.g., I can finish the work anytime I want before the semester ends) and hybrid courses (e.g., I do not have to attend the campus component of the course if I am busy because materials are available online) that may not be true.

The third assessment variable in the study is class grade distribution. This broad measure of student performance indicates that the research cohort earned significantly higher grades when completing coursework in the hybrid format. The grade distribution for the online mode is approximately the same as the campus mode. In general, it appears that the hybrid format is superior and the online mode is inferior in quality based on relative student performance, although a more rigorous methodology with control variables should be employed before any broad conclusions can be reached.

The results are tempered by the observation that faculty might be more inclined to give students the benefit of the doubt with respect to grading as the level of personal interaction increases, which could result in a grading penalty for online students. It is also possible that students selecting the campus or hybrid modes are more concerned about faculty and peer contact as a means of ensuring quality control. Students that prioritize the perception of higher quality might simply be more serious and successful with respect to classroom performance. Hence, the results might be biased by higher quality students self-selecting the campus and hybrid modes. Another possible explanation is that students that enroll in campus or hybrid courses tend to

have lifestyles without excessive time rigidities, which might lead to opportunities to study more and earn higher grades.

The last two assessment terms in Table 1 are student evaluations of faculty and course. The results indicate that student evaluations of faculty and course are significantly lower for the online format than the campus or hybrid alternatives. The implication is that students are not as satisfied with online instruction. An obvious reason for the result is the potential confounding effect caused by the lower grade distribution.

The lack of direct personal interaction is other possible reason students evaluate the online professor and courses relatively low. Annoying pop up windows implicitly requiring student to file evaluations in the online format is also a possible explanation for the lower evaluations, assuming students forced to complete evaluations do so with a negative temperament. Essentially, student in the campus and hybrid instruction modes have the opportunity to complete course/faculty evaluations but are not assaulted with reminders if they choose not to.

## 4.0 MODEL AND RESULTS

The assessment results from the previous section provide a broad multiple comparisons of the campus, online, and hybrid instruction modes. The purpose of this section is to compare the effectiveness of the instruction modes employing a more rigorous methodology. Davisson and Bonello (1976) propose an empirical research taxonomy in which they specify the categories of inputs for the production function of learning. These categories are human capital (admission exam score, GPA, discipline major), utilization rate (study time), and technology (lectures, classroom demonstrations). Using this taxonomy, Becker (1983) demonstrates that a simple production function can be generated which may be reduced to an estimable equation.

While his model is somewhat simplistic, it has the advantage of being both parsimonious and testable. A number of problems that may arise in this type of work (Leach, Neutze, and Zepke, 2001; 1980; Becker, 1983). Among these are errors in measurement and multicollinearity associated with demographic data. Despite these potential problems, there must be some starting point for empirical research into the process by which information systems content is learned if we are to access various proposals as to how the general knowledge of the may best be imparted to our students.

Assume that the production function of learning for computer information systems at the MBA level can be represented by a production function of the form:

(1) $Y_i = f(A_i, E_i, D_i, X_i)$,

where $Y$ measures the degree to which a student learns information systems content, $A$ is information about the student's native ability, $E$ is information about the student's effort, $D$ is a [0, 1] dummy variable indicating demonstration method or mode, and $X$ is a vector of demographic information. As noted above, this can be reduced to an estimable equation. The specific model used in this study is presented as follows:

(2) $SCORE_i = B_0 + B_1 ABILITY_i + B_2 HW_i + B_3 NET_i + B_4 HYBRID_i + B_5 FEMALE_i + B_6 FOREIGN_i + B_7 MAJOR_i + u_i$.

The dependent variable used in measuring effectiveness of student performance is score (SCORE) on the comprehensive final exam. The variable associated with the final exam score is measured in percentage terms. The proxy for student's native ability (ABILITY) is based on the composite score of the GMAT exam plus the product of twice the upper-level (last 60 hours) undergraduate grade point average (GPA). For example, a student with a GMAT score of 600 and 3.5 GPA would have a composite score of 1300. Many business colleges use the composite score as part of the admission process. The percentage score on the homework assignments (HW) measures student effort. The homework grade is used to measure effort since students are not constrained by time, research material, or ability to ask the course instructor questions when completing the ten course assignments.

Enrollment in a campus, online, or hybrid course is noted by the categorical variables NET (online course) and HYBRID. The variable MAJOR is included in the model as a human capital variable identifying students with an undergraduate major or minor in computer information systems (or a related discipline such as computer science). It is anticipated that students with an undergraduate computer background will have an advantage over other students without the computing background in a generalized computer information systems course for MBA students (much like a student with an undergraduate background in accounting should have an advantage in an MBA level accounting course).

The choice as to what demographic variables to include in the model presents several difficulties. A parsimonious model is specified in order to avoid potential multicollinearity problems. The demographic variables in the model relate to gender (FEMALE) and nationality (Foreign). The gender variable is included in the model based on anecdotal evidence that computer information systems is a male dominated field of study (Kearsley, 1998; Okula, 1999).

The model corrects for international students because the majority of international students in the MBA program enroll in the computer information systems course during their first semester of study. Some of the international students find their first semester to be extremely difficult as they adjust to graduate level coursework taught in English. While other authors have found a significant relationship between race and age and learning (Siegfried & Fels, 1979; Hirschfeld, Moore, & Brown, 1995), the terms were not significant in this study. A number of specifications were considered using race, age, MBA emphasis, hours completed, and concurrent hours in various combinations.

Inclusion of these variables into the model affected the standard errors of the coefficients but not the value of the remaining coefficients. For this reason, they are not included in the model. University academic records are the source of admission and demographic information because of the potential biases identified in self-reported data (Maxwell & Lopus, 1994). There are a total of 186 students in the initial sample, 20 students being eliminated from the study for dropping a course (Douglas & Joseph, 1995).

Results from the ordinary least squares estimation of equation (2) are presented in Table 2. None of the independent variables in the model have a correlation higher than .31, providing evidence that the model specification does not suffer from excessive multicollinearity. The equation (2) model explains 55 percent of the variance in final exam performance. Four of the seven independent variables in the model are statistically significant. Of primary interest is the negative coefficient associated with Internet instruction. Holding constant ability, effort, and demographic considerations, students enrolled in the Internet course scored over two percent lower on the comprehensive final exam, although the result is not statistically significant.

The two percent quality differential is not surprising since the online mode is relatively new. It is reasonable to expect the quality gap between the campus and online instruction modes to narrow over time as faculty gain experience in the online environment and technological advances improve mode efficiency. Interestingly, the coefficient corresponding to the hybrid mode reveals that student scores on the final exam are almost four percent higher than the campus alternative and the coefficient is statistically significant. The student performance results verify the grade distribution assessment results of the previous section as the campus and online modes are shown to be approximately the same but significantly lower than the hybrid instruction mode. Hence, the hybrid mode appears to supply quality that is superior to the campus mode with more time independence.

The stability of the model's other coefficients suggests that the model is somewhat robust. Ability as measured by the admission GMAT and GPA composite score has

a positive and significant impact on final exam performance. The variable MAJOR is also positive and statistically significant, implying that students with an academic background in a computer discipline perform at a higher level on the final exam in an MBA level course. The coefficient associated with MAJOR is a relatively large, implying a six percent increase on final exam performance. Student effort as measured by percentage score on homework assignments yields a positive and significant coefficient. The effort variable does not accurately measure the amount of time that a student applied to the course since productivity is different across students.

The effort variable is more of a proxy for willingness to work until complete and adequate homework answers are obtained, organized, and presented to the course instructor. Certainly, ability and effort should be positively related to final exam performance in a random sample of college courses. The two demographic variables in the model are not statistically significant. Hence, gender and nationality does not have a significant impact on final exam performance in this study. Although statistically insignificant at an alpha level of .05 (it is statistically significant at an alpha level of .10), it is somewhat surprising to see that the FEMALE variable has a positive and relatively large coefficient, indicating female students outperformed their male counterparts in a discipline that is widely consider to be male dominated.

## 5.0 CONCLUSIONS AND IMPLICATIONS

This study compares the online, campus, and hybrid modes of instruction. The research results indicate that the pure form of online instruction is the least preferred. Specifically, student performance, faculty evaluation, course evaluation were lower for the online mode of instruction compared to the campus and hybrid alternatives. The results should not be viewed as an indictment of online instruction since the format is still in the initial stage of development. It is almost certain that the gap in student satisfaction between online and campus courses will continually narrow as new technology and faculty sophistication in the environment improve over time via the learning by doing process. For institutions and faculty not willing to fully commit to the online mode at this point, the hybrid mode is a viable alternative that offers some flexibility but maintains the highest quality and student satisfaction. Retention is the only assessment area where hybrid is significantly worse than the campus format. Overall, it appears that personal interaction and community are an important part of the education experience.

The hybrid mode provides a transition between campus and online, maintaining some level of physical interaction. Holding constant factors such as innate ability and effort, graduate students completing course in the hybrid mode tested at a level higher than the

campus and online modes. The results of this study are of a preliminary nature. Further research is needed before any definitive conclusions can be ascertained.

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Table 1
Multiple Comparison of Instruction Modes

|                                          | Campus  | Online  | Hybrid  |
|------------------------------------------|---------|---------|---------|
| Sample Size (courses offered)            | 72 (3)  | 69 (2)  | 45 (2)  |
| Average Enrollment                       | 24.0    | 34.5*   | 22.5    |
| Attrition/Drop Rate (percent)            | 5.55*   | 13.04   | 15.56   |
| Class Grade Distribution (4.0 scale)     | 3.39    | 3.31    | 3.62*   |
| Faculty Evaluation (4.0 scale)           | 3.46    | 3.11*   | 3.51    |
| Course Evaluation (4.0 scale)            | 3.39    | 3.01*   | 3.41    |

* Indicates statistically different than the other two
instruction modes at $p<.05$

Table 2
Estimation of Equation (2)

| Variable  | Coefficient | t-statistic |
|-----------|-------------|-------------|
| Intercept | 2.0475      | 0.31        |
| ABILITY   | 0.0320      | 6.36*       |
| HW        | 0.4925      | 7.95*       |
| NET       | -2.4227     | -1.63       |
| HYBRID    | 3.9212      | 2.22*       |
| FEMALE    | 2.3743      | 1.86        |
| FOREIGN   | -2.7716     | -1.69       |
| MAJOR     | 6.3136      | 2.69*       |

Notes: R-square = .55, F = 27.80, *$p<.05$, and n = 166.