

STILL NO SIGNIFICANT DIFFERENCE?
THE IMPACT OF DISTANCE LEARNING ON STUDENT SUCCESS
IN UNDERGRADUATE MANAGERIAL ECONOMICS

Distance learning in its many forms (via the Internet, television , DVDs, etc.) has increased dramatically in American higher education in recent years and the Education Center Online (2011) reports that 55 percent of all two-year and four-year institutions now offer distance learning courses. Not surprisingly, there have been numerous attempts to evaluate the educational and fiscal efficacy of these distance learning efforts. These studies have generated three general conclusions. First (and disappointingly), distance learning programs seldom generate significant fiscal savings for the institutions that utilize it. Quality distance learning programs can be expensive. Second, there are significant economies of scale associated with distance learning, both at the individual course and institutional levels. The marginal cost of serving a distance learning student is much less than the average cost of doing so. Third, many (though not all) studies find there is "no significant difference" (Russell, 2001) between student learning in distance learning situations versus regular, "bricks and mortar" classrooms. Indeed, the USDOE (2011) concluded that distance learning students actually perform better than bricks and mortar students in the same courses.

It is the "no significant difference" and "they actually do better" conclusions that have evoked controversy because they suggest that many of the traditional bricks and mortar instructional verities academics have relied upon over the centuries do not hold as much water as most professors and administrators would prefer to believe. Historically, large numbers of professors and deans have taken it almost as a given that small class sizes, face-to-face contact

between professors and students, ready physical access to laboratories and library materials, and extracurricular student activities produce more learning, better citizens and a better overall student product. The distance learning empirical literature suggests that some or all of these presumptions may not be valid.

Many empirical judgments about the efficacy of distance learning have been rendered suspect by the absence of valid control groups. Even when distance learning and bricks and mortar students take the same course, if they don't take that course from the same faculty member at the same time, and if they don't have access to the same support, then it is difficult to pin down the impact of distance learning. Thus, almost inevitable variances in student and class characteristics have diminished the validity of numerous empirical studies. This paper seeks to remedy this situation by examining student learning (as measured by course grades) in a control group situation where some students have taken the course in a bricks and mortar situation and others have taken the course via a variety of distance learning modes. However, all students in this sample had the same professor and had the opportunity to listen to that professor's lecture at the same moment in time (albeit via different modes of technology), and to ask questions. All students had the same access to learning support materials via Blackboard.

The controlled statistical experiments reported here provide only nuanced support for the superiority of distance education over bricks and mortar education. It appears that some modes of distance education affect students differently than others. Those modes that encourage live, face-to-face interaction among distance learning students appear to work better and are superior to bricks and mortar approaches. Distance learning modes that make it difficult or almost impossible for students to interact do not work as well and produce results inferior to bricks and mortar situation instruction.

RELEVANT PAST WORK

Most professors would like to believe that their personal efforts in a classroom with students make a difference. They may be correct; however, because it is difficult to measure all of the outcomes of college courses, this has been difficult to demonstrate. The assembled weight of past research, albeit research that often has been lacking in rigor, discourages the view that student learning is degraded by distance learning situations (USDOE, 2010).

An entire web site, www.nosignificantdifference.org, is devoted to the "no significant difference" hypothesis---namely, that there is no significant difference in student learning if the mode of instruction is distance learning rather conventional bricks and mortar classrooms. The site reports 355 "no significant difference" studies and is a follow up to Thomas Russell's 2001 book on the same subject. Yet, these studies seldom address why some students achieve better grades than others when they utilize distance learning, or what choices intelligent administrators (not an oxymoron) should make as a consequence. Further, very few studies have utilized control groups (Maushak et. al, 2001; USDOE, 2010), which is critical if one is to compare distance learning to conventional bricks and mortar learning.

Berge and Mrozowski (2001) have provided an excellent, but dated comprehensive review of 1,419 articles and abstracts concerning distance learning that appeared in journals, or as dissertations, 1990-1999. More than one hundred of these studies focused upon various measure of student success (such as grades, subsequent academic progress, or persistence). Several asked the specific question addressed in this paper---do students learn more or less if they take a course via distance learning as opposed to a bricks and mortar situation?

The most recent and comprehensive review of distance learning studies has been supplied by the U.S. Department of Education (USDOE, 2010), which) commissioned a meta-analysis of

more than 1,000 empirical studies relating to the effectiveness of distance learning. USDOE found on average, students in on-line learning conditions performed modestly better than those receiving face-to-face instruction" (2010, p. ix).

Do individual student characteristics make a difference? Contradictory answers have emanated from past studies (Berge and Mrozowski, 2001; Machtmes and Asher, 2000; USDOE, 2010). It is not yet clear how important to success are student characteristics such as age, gender, etc. Nor do we know very much about how faculty characteristics (gender, race, discipline, experience, etc.) influence student success, though Koch (2005) found perceptible, though small faculty effects on grading in televised instruction. To wit, tenured faculty members and male faculty members assigned lower grades to distance learning students. This, however, could have little or nothing to do with distance learning, per se.

This paper moves us several steps forward in terms of our knowledge because it involves a single course, a single instructor and an invaluable "bricks and mortar" control group of students who took the same course face-to-face from the same instructor at the same time. Thus, many of the control group criticisms that USDOE (2010) has noted do not apply here.

THE DATA AND THE DISTANCE LEARNING MODES

The course in question is Managerial Economics, Economics 301, taught in Spring 2010 at Old Dominion University, a public university in Virginia with an enrollment of approximately 25,000 students. Business majors at Old Dominion must earn a C grade or better in the managerial economics course in order to graduate. One year of principles of economics and an applied calculus course are among the course prerequisites for the course. Managerial economics has earned a reputation among Old Dominion students as a difficult course because, inter alia, it includes applied regression analysis.

This managerial economics course involved the transmission of live televised lectures and activities to 147 students around the United States and a few foreign countries. The broadcasts emanated from an electronic classroom which also contained 29 regular, on-campus Old Dominion undergraduate students.

In this course, regardless of where the students were located, they could see the instructor and talk back and forth to him via voice and e-mail. However the faculty member (a male) could not see most of his students. Distance learning students (those not sitting in the bricks and mortar classroom on-campus) could take the course one of three ways: (1) via television at one of Old Dominion's three well appointed regional higher education centers; (2) via television at one of approximately 20 community colleges sites, mostly in Virginia; and, (3) via video

TABLE 1

**POPULATION CHARACTERISTICS OF MANAGERIAL ECONOMICS CLASS
(N = 147)**

	<u>Mean</u>	<u>Standard Deviation</u>	<u>Percent</u>
Age	28.44	6.39	N.A.
Gender (1 = male)	.432	N.A.	43.2%
African American (1 = African American)	.216	N.A.	21.6%
Asian or Hispanic American (1 = Asian or Hispanic American)	.088	N.A.	8.8%
White (1 = White)	.696	N.A.	69.6%
ODU GPA	2.58	.44	N.A.

ODU Hours	100.67	34.03	N.A.
Math Grade (1 = B or higher)	.293	N.A.	29.3%
Higher Education Center (1 = took course there)	.291	N.A.	29.1%
Community College TTN (1 = took course there)	.304	N.A.	30.4%
TTN USA Video Streaming (1 = took course this way)	.203	N.A.	20.3%
Bricks and Mortar Class (1 = took class this way)	.197	N.A.	19.7%

streaming to whatever location the student chose. Hence, all of these distance learning students were engaged in synchronous rather than asynchronous distance learning.:

Table 1 reports the characteristics of the 147 students. The average age of these students (28.44 years) is older than the typical undergraduate student, either at Old Dominion or nationally. This is characteristic of most distance learning courses aimed at undergraduates. A majority of the students were women. There is some evidence that women are attracted to distance learning programs both because of the schedules and because they may feel they benefit from a greater degree of anonymity (Koch, 1998). Almost 70 percent of the students self-identified their race as white.

Coming into the course, the mean grade point average of the students was only 2.58 on a 4.00 scale and only 29.3 percent of them had earned a B or higher grade in the required prerequisite calculus mathematics course. The oft-cited phenomenon of grade inflation does not

appear to have touched this group of students. They were, however, higher education veterans who on average had completed slightly more than 100 semester hours of work.

Table 1 also reveals that 29.1 percent of the 147 students received the course in an electronic classroom at one of the University's higher education centers (effectively branch campuses), while 30.4 percent received the course in an electronic classroom at a community college. Another 20.3 percent of the students received the course via "Teletechnet USA," the name Old Dominion attaches to its delivery of fully streamed video courses. These students, who must have a good broad band Internet connection to participate, receive the course wherever they wish, usually at home or sometimes at their place of work. Notably, they nearly always are the only individual receiving the course at that site. Hence, they are on their own and neither benefit nor are penalized by interaction with other students.

The remaining 29 students took the course in the conventional way in a classroom on the Old Dominion campus. For them, the only difference from a usual bricks and mortar situation was that the class also was being transmitted to numerous other locations. Therefore, class discussions involved students from these other locations. The 29 students constitute the control group.

EMPIRICAL RESULTS

Table 2 contains regression results from the following estimating equation:

$$(1) \quad \text{Grade} = a + b_i (\text{Demographic Characteristics}) + b_j (\text{Academic Characteristics}) \\ + b_k (\text{Mode of Instruction}) + e$$

where: a = the intercept; b_i , b_j , and b_k are regression coefficients estimated for three classes of variables; and, e = error term.

Demographic Characteristics

Four demographic characteristics were entered as independent variables. Only one of these variables (age) would be statistically significant even at the .10 level if conventional two-tailed tests were applied. However, since the 147 students in the regression constitute the entire population rather than a sample taken from that population, conventional statistical significance tests do not assume their usual meaning. Here, the regression coefficients describe the actual relationship between the dependent variables and the independent variables in this 147 student population. Hence, the standard errors and the t-statistics in this case tell us how variable a particular independent variable characteristic is within this population, not whether it is statistically significant. For example, the age coefficient (.013) tells us that an additional 10 years of age (*ceteris paribus*) raised a typical student's grade by .13 on a 4.0 scale. Older students are more mature and arguably may be better able to allocate their time and resources

TABLE 2

**REGRESSION OF MANAGERIAL ECONOMICS COURSE GRADE
ON DEMOGRAPHIC AND INSTRUCTIONAL MODE VARIABLES**

<u>Independent Variables</u>	<u>Regression Coefficients</u>	<u>Standard Errors</u>	<u>Absolute Values of t-Statistics</u>
Age	.013	.009	1.419
Gender (1 = male)	.168	.132	1.270
African American (1 = African American)	-.041	.165	.248
Asian or Hispanic American (1 = Asian or Hispanic American)	.211	.238	.887

ODU GPA	1.190	.117	10.169
ODU Hours	.002	.003	.722
Math Grade (1 = B or higher)	.555	.151	3.668
Higher Education Center (1 = took course there)	-.097	.215	.452
Community College TTN (1 = took course there)	.217	.212	1.024
TTN USA Video Streaming (1 = took course this way)	-.220	.232	.950
N = 147 R ² = .555 F = 16.81			

than younger students. This may be especially important in distance learning situations where students frequently must be self-motivated and able to proceed on their own.

All of the other demographic characteristics are recorded as conventional 0,1 dummy variables. "White" is the excluded category for self-identified ethnic/racial status and "female" the excluded category for gender. This means that the estimated ethnic/racial coefficients represent departures from the grades predicted for white students. The self-identified status of a student as an African-American was associated with a .041 disadvantage for that student relative to the average white student, while self-identified status as an Asian American or Hispanic/Latino American conferred a .211 grade advantage relative to white students (*ceteris paribus*). Presumably these coefficients capture a variety of ethnic/racial influences, including the academic preparation of the students who enter the course, time spent on task, as well as

other unobserved characteristics. It is wise to keep the possibility of unobserved characteristics in mind when dealing with a cross-sectional regression such as this that explains only 55.5 percent of the variance in the dependent variable.

The positive coefficient on gender (where 1 = male) reveals that male students, on average, achieved a grade .168 higher than female students. This contradicts some previous distance learning research, but is consistent with early previous research about student success specifically in economics courses (for example, Anderson and Fuss, 1994).

Academic Characteristics

Conventional measures of college student academic preparation and ability include a student's high school grade point average and his/her SAT or ACT score. However, these data were not available for numerous students who transferred into Old Dominion after earning an associate degree. Community colleges do not require such scores for admission and Old Dominion's admissions process focuses on students' community college academic performance. In the stead of SAT/ACT scores and high school grade point averages, three other measures of academic performance and aptitude were substituted---each student's grade point average at Old Dominion; how many total hours the student had completed in higher education; and, whether that student earned a B or better in the required prerequisite calculus course.

Each student's existing Old Dominion grade point average coming into the managerial economics course turned out to be a powerful determinant of his/her performance in that course. Each 1.00 increase in a student's Old Dominion grade point average resulted in a grade 1.19 higher in managerial economics. This result underlines what is hardly a mysterious relationship---students with superior overall records (at least as measured by their past academic

performances) achieved much higher grades in managerial economics. This was true even after controlling for variables such as whether the student was a distance learner.

On the other hand, more experienced students (those who had completed more hours in higher education prior to entering the course) scarcely did any better than less experienced students. However, those students who earned a B or better in the calculus prerequisite course did much better (.293). Undergraduate managerial economics is not a course in mathematics, but a previous calculus course (wherever that course was taken) not only appears to provide students with valuable mathematical preparation, but also appears to require or develop analytical and study skills that subsequently transfer well to economics.

Distance Learning Modes Versus Bricks and Mortar

The three distance learning modes were specified as 0, 1 dummy variables. Hence, the coefficients of these dummy variables represented departures in students' predicted grades from what one would predict if those students were taking the course in the face-to-face bricks and mortar classroom. Note that the equation reveals that students who took the course at one of the University's higher education centers (branch campuses) achieved a grade .097 lower than students on campus. Those who took the course at a community college achieved a grade .217 higher. Those who took the course via video streaming achieved a grade .220 lower. All of these estimates hold constant all other independent variable values.

What do these coefficients tell us about the viability of various modes of distance education? The most striking result easily is the .220 penalty students paid on average when they took managerial economics via fully streamed video. This should not surprise because these students effectively are lone wolves who must learn and participate almost entirely on their own. Because they likely are receiving the course over the Internet at their home, or a job

location, or perhaps a nearby library, they seldom have access to fellow managerial economics students to encourage them and to provide them with feedback unless they seek them out via Blackboard chat rooms. In a phrase, there are few external student economies that help them out. Typically, the reason these students are taking the course via fully streamed video is they have unusual family or job situations. Fully streamed video delivery provides them with valuable access to higher education, but it apparent that often this is not an easy path.

Contrast the fully streamed video students with those who took the course at a community college location. In such cases, many students ordinarily are present and students report that a certain camaraderie (an external economy) develops among their student colleagues, who live nearby and share their general circumstances. These students often study together and help each other solve assigned course problems. *Ceteris paribus*, these students achieved a grade .217 than would have been true in the bricks and mortar classroom.

While significant numbers of students also are present at each of the higher education centers, these students frequently have a great deal in common with the fully streamed video students. They are not taking the course on the home campus in the bricks and mortar situation because they frequently have demanding family, work and commuting situations. Other data collected by Old Dominion reveal that these students are more likely to be married and have dependents they must support. Further, they typically work more hours than on-campus students. Typically, they come and go quickly from the higher education center, do not dally there, and are less likely to develop significant relationships with other students. The equation records an apparent penalty---a .097 lower average grade---for students who find themselves in this situation.

In summary, these "other things held constant" results do tell us that students in at least one distance learning mode did much better than students who took the course from the same faculty member at the same time in a conventional bricks and mortar classroom. By the same token, students in two other distance learning modes did not do as well as students who took the same course in a bricks and mortar situation.

FINAL WORDS

This study is not definitive where the effectiveness of distance learning is concerned. Its virtues are a reasonably large sample and the presence of an oft-desired, but seldom present, legitimate control group (Machtmes and Asher, 2000, USDOE, 2010). Its deficiencies include an excess of unobserved characteristics relating to students' academic preparation, family responsibilities and work situations. Nevertheless, this study does supply more demographic and academic control variables than most distance learning studies. Further, relatively few past distance learning studies have been able to contrast the effectiveness of several different synchronous distance learning modes.

The results here should inspire caution among those who make strong statements about the efficacy of distance learning (for example, USDOE, 2010). Like Campbell's Soups, distance learning now comes in so many varieties that it is increasingly difficult to generalize about it. Certainly this is true with respect to the costs and scale economies associated with various distance learning modalities and it should hardly be a surprise if individual student success in distance learning depends substantially upon the mode of distance learning each student utilizes.

There is another caution flag that must be flown. Researchers seeking to pinpoint the overall efficiency of distance learning should heed the caveats issued by Friedman and Schwartz (1991), Christ (1993), and Tomek (1993), each of whom warned against reaching strong

conclusions based upon the statistical significance of coefficients in single regression equations. They argue that we should pay more attention to results that are repeatedly confirmed in rigorous testing circumstances than we do to results that emanate from a single study. This warning has special relevance to distance learning research (including this study) because relatively few empirical analyses relating to distance learning have been able to assemble valid control groups.

Finally, this study doesn't address asynchronous distance learning modes, which are numerically dominant in the distance learning commercial space. Asynchronous courses involve students who receive their course materials and communications over the Internet at varying times, or who perhaps receive course contents on a DVD. That said, the finding of this study that student interaction and the presence of distance learning student colleagues enhances student success should be of concern to asynchronous distance learning programs because face-to-face student interaction is sparse in such situations.

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