

Testing the Effect of Hybrid Lecture Delivery on Learning Outcomes

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Abstract

Empirical studies have yielded mixed results with regard to the issue of whether the online and traditional modalities have equivalent effects on learning outcomes for courses taught at the Master of Business Administration (MBA) level. A majority of these empirical studies support the conclusion of no significant difference between the modalities. However, only a small percentage of these studies address the issue of self-selection bias, and fewer study the hybrid format. This paper reports on a study that contributes to the existing MBA literature by employing a research design that appropriately handles self-selection bias in the context of a hybrid course. The key finding of the study is that the effect of the online format on learning outcomes does not handicap outcomes relative to the traditional format.

Keywords: hybrid delivery, blended learning, business education, economics education, MBA courses

Introduction

Online enrollment continues to increase at a fast pace. Between 2002 and 2011, the online enrollment share of total enrollment in postsecondary institutions rose from 9.2% to 32% ([Allen & Seaman, 2013](#)). A recent U.S. Department of Education Survey ([Means, Toyoma, Murphy, Bakia, & Jones, 2010](#)) concluded that hybrid and online modalities are more effective than traditional instruction, yet faculty acceptance of online courses has risen only marginally from 27.6% in 2002 to 30.2% in 2012 ([Allen & Seaman, 2013](#)). The low faculty acceptance rate reflects continuing concerns that, relative to traditional lecture delivery, online courses have lower student engagement, lower course completion rates, and lower learning outcomes ([Xu & Jaggars, 2013](#)).

To increase faculty acceptance, Web instruction needs to develop equivalence between "digital" and "live" communication in peer and instructor interactions. Frequently cited disadvantages of online learning are isolation and lack of media richness ([Cater, Michel, & Varela, 2012](#); [Sapp & Simon, 2005](#); [Stansfield, McLellan, & Connolly, 2004](#); [Xu & Jaggars, 2011](#)). Isolation encompasses insufficient peer and instructor interaction, which leads to low engagement and lower course completion rates. Media richness encompasses the attributes of face-to-face (F2F) communication of verbal speech intonations

and nonverbal facial and body expressions. Offset mechanisms need to be developed to effectively deliver interactive activities and online discussion forums that increase the quantity and quality of peer and teacher interactions ([Sitter, Carter, Mahan, Massello, & Carter, 2009](#)). Examples are collaborative team-building activities using social media and desktop or web-based video conferencing ([Middleton, 2010](#); [Sitter et al., 2009](#)).

Mixing online lectures with traditional lectures in the same course might promote equivalence between "digital" and "live" communication. In a rotating format, the traditional lectures could potentially marry the advantages of the two modalities. The often cited advantages of the online format, which are viewed as disadvantages of the traditional format, include a self-paced format, flexibility in scheduling, convenience in viewing and re-viewing lectures, and savings from reduced commuting time and expense ([Ealy, 2013](#)). The often cited advantages of the traditional format (conversely, disadvantages of online courses) include the discipline imposed by attending class at a fixed time, impromptu explanations and examples developed in response to live questions, and greater stimulation than when working alone ([Ealy, 2013](#); [Sitter et al., 2009](#); [Terry, 2007](#)).

In principle, the hybrid approach in the graduate business school context looks promising to many scholars. Many Master of Business Administration (MBA) programs are moving from the traditional delivery to one that combines traditional meetings and online learning, in part because more students want the MBA without having to give up their jobs, relocate, or attend evening classes during the week ([Middleton, 2010](#)). This hybrid modality emulates the practices of global business since 9/11 to substitute F2F meetings with virtual communication technologies (Hochberg, 2006).

The research question of this study asks whether the learning outcome for online instruction is equivalent to traditional instruction when the delivery modes are rotated throughout the course. The hybrid modality is based on marrying the advantages of both formats, and the authors' approach is an empirical examination of whether the advantages of this marriage are reflected in equivalence of learning outcomes.

The second section reviews the empirical literature on the equivalence of learning outcomes for the online, traditional, and hybrid modalities. The third section contains a discussion of the authors' data and empirical model, and the fourth section reports the estimation results. The final section contains a summary and conclusions.

Literature Review

The conclusion of four recent and extensive surveys of empirical studies of equivalence among delivery modalities is that online is at least equivalent to traditional ([Cater et al., 2012](#); [Lack, 2013](#); [Means et al., 2010](#); [Russell, 2010](#)). The website [No Significant Difference](#) ([Russell, 2010](#); see also Russell, 2001) catalogues several hundred empirical studies on the equivalence issue. The variety of the studies is large: they range in date from 1928 to the present, they cover K-12 through graduate courses, and they range from small sample observational studies to large-sample studies with rigorous experimental designs. Overall the "great majority" of the studies are classified as reporting the "no significant difference" finding.

In a report prepared for the U.S. Department of Education, [Means et al. \(2010\)](#) surveyed published studies between 1996 and 2008 that compare online versus traditional classroom delivery. They winnowed down in excess of 1,000 studies to a sample of 45 that met a selective standard for research methods. For this sub-sample, which covered K-12 and post-secondary institutions, they report that the learning outcomes for the online and hybrid modalities are slightly higher than for the traditional classroom, and the difference is statistically significant at the .001 level. Additionally, [Lack \(2013\)](#) surveyed 30 studies of undergraduate courses, and [Cater et al. \(2012\)](#) surveyed 26 studies of business courses, and each concludes that the majority of the studies report the finding of no significant difference.

There are several large-sample studies of equivalence that report consistent but mixed findings. On the one hand, two studies in the context of a 4-year college program report that online outcomes are at least equivalent. [Bowen, Chingos, Lack, and Nygren \(2012\)](#) studied a large enrollment introductory statistics class at six public universities in the U.S. Northeast. The students are randomly assigned to either a traditional or hybrid class, and out of a course enrollment of about 3,046 students, 605 participated in the study. The study reports a finding of no significance difference. While researching "Factors Affecting Student Performance and Satisfaction in Distance Learning Courses," the authors studied a sample of

3,491 students enrolled in online or traditional courses at an engineering college and report that students in the online courses had higher learning outcomes ([Carpinelli, Calluori, Briller, Deess, & Joshi, 2006](#)). On the other hand, in two studies of statewide community college systems, each reports learning outcomes are lower for students in online courses. [Xu and Jaggars \(2011\)](#) tracked 50,000 students from [Washington State community and technical colleges](#) who initially enrolled in 2004 for 5 years, and the [Colorado Department of Higher Education \(2012\)](#) examined a sample of 4,585 students enrolled in either an online or traditional science course in the [Colorado Community College System](#). These studies report that less academically prepared students find it more difficult to learn from online courses.

The gold standard for rigorous experimental design is the randomized trial ([Lack, 2013](#)). When the students in the study have self-selected the delivery modality, then the concern is that the effect of the student characteristics will be unfiltered. As this approach is just beginning to emerge in the equivalence literature, to the authors' knowledge, there are currently only a handful of equivalence studies that employ a randomized trial design ([Bowen et al., 2012](#); [Figlio, Rush, & Yin, 2010](#)). All other studies use samples where students self-selected the course, and only a relatively small percentage ([Anstine & Skidmore 2005](#), reviewed below, is one) of these studies used procedures to address bias resulting from students self-selecting the course. For this reason, critics question the significance of the findings of most previous studies ([Lack, 2013](#); [Means et al., 2010](#)).

Table 1 summarizes the findings of the aforementioned studies, particularly in relation to how learning outcomes achieved through online delivery compare with those achieved through traditional, face-to-face instruction.

Table 1. *Extant empirical studies comparing outcomes in traditional (face-to-face) and online learning*

Empirical Study	Self-Selection Bias Corrected?	Findings
<i>Compilations of studies</i>		
Cater et al., 2012	No	Online = Traditional
Lack, 2013	N/A	Online = Traditional
Russell, 2010	N/A	Online = Traditional
Means et al., 2010 (for U.S. Dept. of Education)	N/A	Hybrid > Traditional > Online
<i>Large-sample studies</i>		
Bowen et al., 2012	Yes	Online = Traditional
Carpinelli et al., 2006	No	Online > Traditional
Colorado Department of Higher Education, 2012	No	Online < Traditional
Xu & Jaggars, 2011	No	Online < Traditional
<i>Studies involving business courses</i>		
Anstine & Skidmore, 2005	Yes	Online < Traditional (Statistics) Online = Traditional (Managerial)
Campbell, Floyd, & Sheridan, 2002	No	Online > Traditional
Carrol & Burke, 2010	No	Online = Traditional
Gibson, 2008	No	Online < Traditional
Larson & Sung, 2009	No	Hybrid = Traditional = Online
Navarro & Shoemaker, 1999	No	Online = Traditional

Note. All of the studies use exam scores as the measure of learning outcome.

This study is concerned with equivalence of modalities in the business school environment at the MBA and undergraduate levels. The authors conducted an extensive literature search of studies published since 1999 and located six studies that met the following criteria: comparison of a matched pair of online and traditional sections that were either taught in an MBA program or as an undergraduate business class, the sections used the same textbook and final exam, and the study compares differences in learning outcomes based on end-of-semester test scores.

[Anstine and Skidmore \(2005\)](#) studied two matched pairs of traditional and online courses: one in statistics, and the other in managerial economics. The students in their sample were in a program that offers an MBA degree in traditional classes or entirely online. The students self-selected the instruction format. Within the paired courses the section sizes were unbalanced. In the statistics course there were 21 students in the online section as compared to 12 in the traditional section. And, conversely, in the managerial economics course there were 18 students in the online section and 27 in the traditional section. The instructor, textbook, assignments, and exams were identical for the F2F and online sections of the statistics and managerial economics courses, respectively. The online class had access to PowerPoint slides with audio overlay, and students were encouraged to participate in online discussion. Anstine and Skidmore used exam scores as the measure of learning outcomes and used the Heckman procedure to correct for sample selection bias. On a take-home final exam, after controlling for student characteristics and selection bias, students in the online format of the statistics class had exam scores 14.1 percentage points lower than in the traditional format, and the difference was statistically significant at the .01 level, whereas the exam scores for the pair of managerial economics classes were not significantly different.

[Campbell, Floyd, and Sheridan \(2002\)](#) studied a matched set of five traditional sections and an online section of an undergraduate accounting principles class. The students self-selected the instruction format. The traditional sections were taught by two different instructors and averaged 25 students per section. The online section was taught by a third instructor and had 14 students. All instructors used a common syllabus and the same textbook, assignments, and comprehensive final exam. The online class viewed publisher-prepared PowerPoint presentations and were encouraged to participate in a 1-hour weekly synchronous chat discussion forum (participation was not part of the grade). Campbell et al. used exam score as the measure of learning outcomes and did not correct for sample selection bias. They report the mean score on a proctored final exam was 14.3 percentage points higher for the online students, and the difference was statistically significant at the .000 level.

[Carrol and Burke \(2010\)](#) studied a matched pair of traditional and online sections of an MBA class in organizational theory. The students self-selected the instruction format and each section averaged 26 students. Different instructors taught the sections, but the instructors used the same textbook and final exam. The online students were required to participate in online discussion. Carrol and Burke used exam scores as the measure of learning outcomes, did not correct for sample selection bias, and report no statistically significant difference in the mean score on a proctored final exam between the two instructional formats.

[Gibson \(2008\)](#) studied a matched pair of traditional and online sections of an MBA class in human resource management. The students self-selected the instruction format; there were two online sections with a total of 24 students, and a traditional section with 14 students. All students had full-time jobs. The same instructor, using the same course content and exams, taught the sections. The traditional class met on five weekends during a 12-week term. The online class viewed the same PowerPoint presentations as were presented to the traditional class and were required to participate in weekly asynchronous online discussion forums and graded on their participation. Gibson used exam scores as the measure of learning outcomes, did not correct for sample selection bias, and reports that the mean score on a proctored final exam was 3.4 percentage points higher for the traditional sections compared to the online section.

[Larson and Sung \(2009\)](#) studied a matched trio of traditional, online, and blended sections of an undergraduate business school course in management information systems. The students self-selected the instruction format. The online section had 22 students, the traditional had 63 students, and the blended had 83 students. The sections were taught by the same instructor, using the same textbook, supporting materials, and exams. The online section used publisher-provided lecture notes, and participation in weekly asynchronous threaded discussion was required. The blended section met 11 times for lectures in traditional format, and five times for lectures in online format. For the latter the blended students received the same lecture materials and requirement for online discussion participation as the online students. Larson and Sung used exam scores as the measure of learning outcomes, did not correct for sample selection bias, and report no statistically significant difference in average score on a proctored final exam for the three different formats.

[Navarro and Shoemaker \(1999\)](#) studied a matched pair of traditional and online sections of an MBA class in macroeconomics principles. The students self-selected the instruction format, each section had

approximately 30 students, and all students lived off-campus and had full time jobs. The same instructor using the same course content taught the sections. The online class viewed PowerPoint presentations prepared by the instructor with audio overlay, animated diagrams, and an interactive portion requesting student feedback to question prompts. Students in both sections were encouraged to participate in a weekly asynchronous threaded discussion board and in a 1-hour weekly synchronous chat discussion forums (participation was not part of the grade). The authors used final exam scores as the measure of learning outcomes, did not correct for sample selection bias, and reported no statistically significant difference in average final exam score between the two formats.

Table 2 summarizes the salient characteristics of the five studies of six courses. Three casual observations are suggested. First, balance in the section sizes may be underappreciated. In the first listed study, [Campbell et al. \(2002\)](#) report that the online format is better than the traditional, and in the study the size of the online section is only 14 as compared to 25 for the traditional section. In the last two studies, it is reported that traditional is better than online, and in these studies the traditional section contains only 12 students, as compared to 21 and 12, respectively, for the online sections ([Anstine & Skidmore, 2005](#); [Gibson, 2008](#)). Second, on balance 57% (4/7) of the paired sections support the conclusion that there is no significant difference in the effect of online delivery format and traditional delivery format on learning outcomes. Third, although in each of the six studies students self-select the delivery format, only one study ([Anstine & Skidmore, 2005](#)) corrects for sample selection bias. The contribution of this study is to use an experimental design that controls for self-selection bias. The authors' experimental design uses a course taught in hybrid format, where, on a rotating basis, the students experience both modalities of a traditional lecture and an online lecture.

Table 2. *Studies comparing online and face-to-face modalities in business courses*

Study	Correct for Selection Bias?	Finding	Course	Online Sect. Size	F2F Sect. Size	Online Discussion	Business School Type
Campbell, Floyd, & Sheridan, 2002	No	Online > Traditional	Accounting	14	25	Encouraged	UG
Anstine & Skidmore, 2005	Yes	Online = Traditional	Managerial Economics	27	18	Encouraged	MBA
Carrol & Burke, 2010	No	Online = Traditional	Organizational Theory	26	26	Required	MBA
Navarro & Shoemaker, 1999	No	Online = Traditional	Macro-economics	30	30	Encouraged	MBA
Larson & Sung, 2009	No	Online = Traditional = Hybrid	Management Information Systems	22	63	Required	UG
Anstine & Skidmore, 2005	Yes	Online < Traditional	Statistics	21	12	Encouraged	MBA
Gibson, 2008	No	Online < Traditional	Human Resource Management	12	12	Required	MBA

Note. Sect. = section, F2F = face-to-face (traditional), UG = undergraduate. All the studies use exam scores as the measure of learning outcome.

Empirical Framework

The data for the present study come from a required *Principles of Economics* class taught in an MBA program. This course was designed for students who did not take economics as undergraduates. If the student took economics and had two undergraduate courses in economics with grades of B- or better, they were able to waive this course. The course covered both microeconomics and macroeconomics. All

18 chapters in the textbook were covered in this course, consisting of two introductory chapters, eight microeconomics chapters, and eight macroeconomics chapters. Although the majority of the students in the course were MBA students, the class included students from a graduate program in engineering management who were eligible to take certain courses in the MBA program. The rule for admission into the MBA program was that students generally needed to have a Georgetown Index of 1,100 or above. The Georgetown Index is 200 times their undergraduate grade point average (GPA) plus their [Graduate Management Admission Test \(GMAT\)](#) score. The School of Management offering this course was a small program in the setting of a liberal arts college. The students in this program were generally not exposed to courses that were offered in an online format. Five of the eight microeconomics chapters and six of the eight macroeconomics chapters were taught in a traditional lecture format using PowerPoint slides. For the remaining five chapters, the lecture was recorded in a PowerPoint presentation and made available electronically. Homework problems were assigned for each chapter. For the traditional lectures the answers to the homework problems were reviewed in class, time permitting; for the online chapters, the solutions to the homework problems were made available electronically. For the most part, the chapters alternated between being covered traditionally or online. In reviewing the difficulty of the 47 questions, there was no statistically significant difference (at the .05 level) in the difficulty level (using the publisher test bank difficulty rankings) reported between the 32 questions on content covered in the traditional format or 15 questions on content covered in the online format. The chapters covered online included both microeconomics and macroeconomics chapters, as did the material covered in the traditional method.

A midterm covered the two introductory chapters and the eight microeconomics chapters; a final exam covered the eight macroeconomics chapters. The exams consisted of two parts: Part 1 was multiple-choice questions, and Part 2 was problems. The multiple-choice questions were mostly conceptual, although some were numerical problems. The textbook's test bank provided all questions and a degree-of-difficulty figure for each on a scale of 1 to 5. We used responses to the 47 multiple-choice questions to compare student performances from the online portion and traditional lecture portions of the courses. Descriptive statistics are reported in Table 3.

Table 3. *Descriptive statistics*

Variable	N	M	SD
C (1 if correct, 0 otherwise)	1711	0.69	0.46
Correct Online	767	0.68	0.47
Correct Traditional	944	0.69	0.46
<i>Question-specific variables</i>			
O (1 if covered online, 0 otherwise)	1711	0.45	0.50
E (1 if final, 0 if midterm)	1711	0.50	0.50
D (Question difficulty scale 1 to 5, hardest)	1711	2.93	1.27
<i>Student-specific variables</i>			
MBA_Eng	36	0.23	0.42
GPA_U	36	3.33	0.35
GPA_G	36	3.50	0.31
G (1 if female, 0 if male)	36	0.44	0.50

Students correctly answered 68% of the questions dealing with content delivered in the online format, and they correctly answered 69% of the questions dealing with content delivered in the traditional format. However, without holding constant the effect of the other variables, comparing means doesn't suggest that either teaching format is more effective than the other. From the question-specific variables, the average difficulty level of the questions was 2.93 (on a scale of 1 to 5), and 45% of the questions were covered in the online format. From the student specific variables, 77% of the students were in the MBA program, and 23% were in the Graduate Engineering Management program. The students had an average undergraduate GPA of 3.33, an average graduate GPA of 3.50 (at the time they were taking this class), and 43% of the students were female.

The course was taught in a hybrid format of rotating online lectures and traditional "live" lectures. Because the students did not have a choice as to which type of lecture format to take; thus, self-selection bias is precluded. Though economic concepts by their nature build on each other, the overlap of concepts in one lecture format to the other was minimal.

The empirical model takes the following form:

$$(4) C_{ij} = B_0 + B_1 ON_i + B_2 E_i + B_{3k} D_{ik} + B_4 MBA_j + B_5 MBA_j + B_6 GPA_U_j + B_7 GPA_G_j + B_8 G_j + U_{ij}$$

where C_{ij} – correct; 1 if student j has the correct answer for question i , 0 otherwise

Question-specific independent variables:

- ON_i – online; 1 if the chapter that question i was taken from was covered online, 0 otherwise
- E_i – exam; 1 if question i was from the final, 0 for the midterm
- D_{ik} – vector of indicator variables for difficulty level of question i ; $k = 2, 3, 4, 5$ (where 5 is the most difficult)
- S_i – semester; 1 if question i was from Fall 2010, 0 representing the question being from Spring 2006

Student-specific independent variables:

- MBA_j – 1 if student j is an MBA student, 0 if he/is is an engineering management student
- GPA_U_j – undergraduate GPA of student j
- GPA_G_j – graduate GPA of student j
- G_j – gender; 1 if student j is female; 0 if male
- U_{ij} – random error term for student j and question i

Results

The logit estimation results are reported in Table 4.

Table 4. Exam performances and class format

Variable	Logit Model	
	Coefficient	Pr > ChiSq
ON (cov. Online = 1)	0.20	0.0997
GPA_G	0.99	0.0001
GPA_U	0.04	0.8196
MBA	-0.17	0.4052
G (Gender)	-0.29	0.0118
E (Exam 2 = 1)	-0.43	0.0002
Q_Diff_2	-0.63	0.0147
Q_Diff_3	-0.47	0.0041
Q_Diff_4	-0.15	0.6009
Q_Diff_5	-0.98	0.0001
S (Fall 2010 = 1)	-0.16	0.3586
Intercept	-1.81	0.0144
N	1,711	
Likelihood Ratio	86.36	0.0001

Note. The estimation results for the 35 student indicator variables are not reported here.

Because the focus of the present study is the equivalence of the online and traditional modality, the authors concentrate the discussion on the estimation results for "ON," the indicator variable for the online modality. *The coefficient for the variable "ON" is positive and significant at a p-value of .0997. While this exceeds the .05 significance level and therefore is not highly significant, it does suggest that in the context of a hybrid design, the advantages of online learning at least offset its disadvantages.*

Whereas, the positive coefficient for the online modality is not as strong reported by [Campbell et al. \(2002\)](#) – they report a positive coefficient at the statistical significance level of .000 – it is consistent with the equivalence findings of [Anstine and Skidmore \(2005\)](#), [Carrol and Burke \(2010\)](#), and [Navarro and Shoemaker \(1999\)](#). The authors' finding suggests that in the context of a hybrid design the advantages of online learning at least offset its disadvantages.

A numerical calculation illustrates the estimated effect of the online modality relative to the traditional modality in our sample data. The effect of the estimated logistic coefficient on the odds ratio of getting a question correct is computed by raising the natural logarithm to the power of the estimated coefficient. Thus, for the estimated coefficient of 0.20 the odds of a correct answer are increased by 22% ($\exp. \text{ of } 0.21 = 1.22$), if the question is on material that was covered in the online format. Converting this to probability, the chances of responding correctly to a question are predicted to increase from 69%, if the material was covered in traditional format (the mean for percentage correct in traditional lecture shown in Table 3), to 84.2% if the material was covered in online format. A principal limitation of the present study is the small sample size ($N = 36$). This is not uncommon for studies of individual classes, but it does imply the need for further research.

Conclusion

The issue of "no significant difference" between online and traditional instruction formats is important for administrators considering expanding MBA offerings in the hybrid and online modalities. While the availability of Web instruction significantly expands these opportunities, the appeal would be less if the online mode of instruction inherently handicaps learning outcomes.

The sample for this study comes from a *Principles of Economics* class taught to MBA students and graduate engineering management students who could not waive the class. The class was taught in a hybrid format of rotating lectures between online and traditional lecture formats. The study estimates a qualitative choice model in which the probability of a correct response is estimated from question-specific characteristics and a set of indicator variables for each student that captures the effect of differences in unobservable student characteristics (such as motivation, maturity, and independent learning skills). From the estimation results we have calculated that the chances of responding correctly to a question are predicted to increase by 23% if the material is covered in an online format compared to a traditional format. Because the estimated coefficient is statistically significant at the .10 level, the authors conclude that the online format does not handicap learning outcomes for graduate-level students.

Informally, students reported that in the online format they were able to listen to the PowerPoint slides at a time that was conducive to learning and to listen to the slides repeatedly, which they were not able to do with the traditional format. They reported that the principal disadvantage of the online format was not being able to ask questions immediately upon having difficulty understanding a particular concept covered on the PowerPoint slides. Similar student comments on the advantages and disadvantages of the hybrid format are reported in ([Ealy, 2013](#)). The estimation results suggest that (for this sample of graduate students) the advantages of online learning at least offset its disadvantages when taught in the hybrid format of an alternating schedule of traditional and online lectures. Directions for further research would include replication in larger samples and in different institutions. Because the authors' design employs a hybrid course, which is becoming a popular format in MBA programs, they believe the results will be of interest to administrators of these programs.

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