

Understanding the Impact of Online Instruction and Blended Learning Methods for an Undergraduate Business Decision Making Course

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Abstract

With the advent of laptop technology, the conventional classroom delivery of an introductory class to quantitative decision making has to be re-evaluated. Two distinct forms of instruction are presented: a) completely online delivery and b) a blended approach. Using the same course material, content and course learning outcomes, we observe that in the online mode, students found the course intensive and only the extremely dedicated students completed the course successfully. The recordings were found to be an essential part of the learning experience. For the blended mode, where recorded lectures were optional, students reported that the recordings improved their confidence in the material being mastered and helped in achieving overall course objectives. For both forms of instruction, an electronic homework delivery system was used. A strong correlation was observed between course grade and average homework grade for both the online and the blended model.

Keywords: E-learning, Blended Learning, Web-based Learning

Introduction

In the past, a typical learning model involved students solving assigned problems manually (utilizing the formulas introduced during the lecture period). These problems would be submitted to the instructor who would hand-grade them and return them to students as soon as possible. With the advent of computer technology, this model needs to be re-evaluated. Two technology based approaches have recently emerged, blended learning vs. completely online delivery. The difference between blended learning and online delivery is that blended learning is a formal education program in which a student learns *at least in part* through online delivery of content and instruction with some element of student control over time, place, path or pace. The alternative discussed in this paper is online delivery, which is when learning occurs entirely through online delivery of content and instruction with no face-to-face interaction with the instructor.

In this paper, we analyze each mode in the context of two focal learning outcomes. These are (a) to develop and apply quantitative tools to business problems, and (b) to learn how the computer can be used as an aid to solve quantitative business problems. Both learning outcomes are measured using a combination of qualitative feedback as well as a quantitative analysis of homework and exams scores.

The paper is organized as follows. In Section 2 we provide a literature review. Section 3 describes the methodology which also includes a description of the recorded lecture innovation. In Section 4, we

discuss the results of our observations including the advantages and disadvantages of the electronic homework mechanism. We demonstrate the results from both groups (blended and online) who participated in the experiment. The results of the online group are limited to a single pilot run (Summer 2010, where the course was delivered in an accelerated mode over five weeks in the summer), whereas for the blended group we report on three sections, two from Fall 2010 and one from Spring 2011. The blended course sections each ran over a semester long, thirteen week schedule. In Section 5 we provide conclusions and recommendations.

Literature Review

With the explosion of technology, a variety of new teaching models have been developed and applied to replace and supplement face-to-face teaching. These include blended learning and completely online delivery. The earlier research on these various forms of learning has focused on the differences between the technologies; see for example (McCown, 2010) who discusses the benefits of blended courses for a clinical laboratory science class. While some universities are moving towards delivering such courses in an online mode, research has demonstrated that students still benefit from regular student/instructor interaction (Kruse, 2010).

The research in (Rayner, 2010) highlighted significant differences between the performance of the e-learning and face-to-face groups with e-learning students performing poorly when compared to their face-to-face peers. When considering how classroom-delivered courses should be integrated as online courses, the authors in (Smart, 2006) report that this integration should be carefully planned based on learner characteristics, course content, and the learning context. (Burrell-Ihlow, 2009) provides a case study as an example of how to implement a blended learning course. The lessons learned are particularly important in the context of a quantitative business class: students require interaction with the instructor in order to master the required learning goals.

With regard to the comparative modes of learning, (Verkroost, Meijerink, Lintsen, & Veen, 2008) and (Tang and Byrne, 2007) describe the advantages of blended learning vs. online learning. The research finds that students appeared more satisfied with the blended learning model. A similar conclusion is drawn by (Tucker and Jones, 2010) who highlights how the blended learning approach improves student learning and cost effectiveness in a business school context. The authors in (López-Pérez, Pérez-López, Rodríguez-Ariza, & Lázaro, 2011) concur with this result and demonstrate that the use of blended learning has a positive effect in reducing dropout rates and in improving exam marks. The study by (Bains, Reynolds, McDonald, & Sherriff, 2011) is interesting in that it compares all three approaches (blended, e-learning and face-to-face) for a group of orthodontic students. The statistical analysis suggests that blended learning is more likely to be both accepted and effective than either face-to-face learning or e-learning alone, which is also the conclusion of a qualitative study by (Bliuc, Ellis, Goodyear & Piggott, 2011). Likewise, in a wellness course, the work by (Everhart and Dimon, 2013) indicates that respondents improved their cardiovascular endurance patterns more if they were in the traditional or blended delivery format than if they completed the wellness course totally online. Regarding student satisfaction, (Martinez-Caro and Campuzano-Bolarin, 2011) show that satisfaction differs across the traditional and blended learning methods and the authors conclude that student satisfaction is greater in blended courses than in face-to-face courses. One possible reason for this is the levels of class attendance, motivation and collaboration with classmates which were higher in blended learning than in classroom instruction.

The challenge in implementing these non-traditional teaching methods remains to be in terms of measuring the teaching effectiveness of blended learning vs. online learning. (Means, Totama, Murphy, & Baki, 2013) conduct an extensive study of this problem and have found that, on average, students in online learning conditions did perform modestly better than those who received face-to-face instruction.

The advantage over face-to-face classes was significant in those studies contrasting blended learning with traditional face-to-face instruction but not in those studies contrasting purely online with face-to-face conditions. A similar conclusion has been observed by (Francis and Shannon, 2013) who demonstrate that in an engineering context, students who do not engage with blended learning are academically disadvantaged. But a remaining question is how to align the blended mode of delivery within the course of interest and what the level of integration of the new technologies should be. This is the subject of our research. This paper examines the extent to which non-traditional teaching methods may be used to improve learning outcomes in an undergraduate business course context as well as to understand the degree to which these planned innovations should be integrated. We measure the success of the learning outcomes via final exam scores and homework scores.

Methodology

In this paper, we analyze two technology based learning approaches blended learning vs. completely online delivery. For each learning approach, both the course objectives and the course content remained the same. We first describe a blended model in which conventional classroom instruction takes place bi-weekly, yet the material is re-enforced via web-based learning methods such as recorded lectures and online homework. We then describe a completely online version of instruction in which the same course content is delivered exclusively via the Internet with no face-to-face interaction.

Both forms of instruction described in this paper benefit from two teaching innovations, first the use of non-intrusive recorded lectures in which the entire lecture including all key strokes, screens and sound is recorded during a conventional class. The lecture is then processed and an integrated multimedia file is posted to Blackboard after class. Students benefit from being able to review the class in a self-paced manner. The second innovation is the use of electronic homework tests which are posted via Blackboard and graded automatically.

During the course of teaching this quantitative methods class, we have found that students are on the whole interested in using their computers to achieve success in their learning. The main challenge in a quantitative methods course is catering for an extremely mixed audience. While some students are technically savvy, others lack some basic skills. This study attempts to bridge this gap by developing a toolbox of learning objects which will cater to these needs by providing continuous support and feedback and simultaneously challenging the stronger student.

In a quantitative methods class, students are capable of absorbing the concepts presented during the lecture, but fail to comprehend the Excel methods required in order to analyze the data. This deficiency can easily be overcome by providing additional resources in the form of interactive learning objects which can be viewed in a self-paced manner outside the class. Students find that watching an interactive example at their own pace is more beneficial than reading through a printed handout explaining the steps.

We use Camtasia (2010) software to record the lecture including all screens and keystrokes used as part of the concept being taught. For each topic, a series of labeled examples are created for the student to download, view and listen to in his/her time. Moreover, it is possible for the student to self-pace the work by fast-forwarding to a problem area he/she faces or by repeating aspects of the example that require further understanding. The advantage of the recording is that students can pause the example and try the problem themselves with the aid of the interactive tutor.

As an example, consider a forecasting problem which involves a sequence of steps which include graphical presentation of the data, regression modeling and dealing with seasonality in the data. During a class, students are often overwhelmed by the complexity of the stages involved and lose track of the end goal which is to produce a reliable forecast. Confusion sets in as a result of missing a single link in the chain of events leading to the forecasts. By recording the forecasting example, the student can re-create

the Excel model, and use the interactive learning object to clarify the material by listening to the instruction and applying the step-by-step methods in their own time.

Results from the Pilot Study

Online Group. The recorded lectures for the online group represented a crucial form of the delivery of this course. Free form comments regarding the use of recorded lectures are summarized below:

- “I liked the Camtasia recordings, but would have preferred an instructor led course”,
- “I liked the online format and the Camtasia recordings for review really helped me understand the material”.
- “I liked the Camtasia recordings. I don't think I could have passed the course without them as this was an online class”.
- “These recordings are crucial in an online course such as this one”.
- “I liked having the recording of all the lectures available”
- “I was very happy with the Camtasia recordings and loved that I had the lecture in order to learn the material”

In contrast to the positive feedback on the Camtasia recordings, most of the freeform comments (except for one) included a comment that they did not like the online format and the heavy use of technology was unattractive, and stated they would have preferred a conventional instructor-based course. Another common complaint was the difficulty in doing team work, with the dominant preference being to produce the work on one's own rather than wait for responses from virtual team-members. It would appear that the face-to-face element is not easy to replace.

Blended Group. The students in this group were administered a more detailed questionnaire about their experience with the Camtasia recordings. Most of the students offered positive feedback in the freeform comments section, for example

- “Very helpful in all aspects, should be used in all courses”
- “It helped me reinforce what I learned in class, and I used the recorded lectures to study as well. It was very useful.”
- “Excellent, sometimes students have trouble keeping up w/the class or miss a class and the recorded lectures make the materials accessible”.
- “It allowed me to re-listen as many times as I needed and at my convenience. I found it a great way to reinforce the lesson in class”.
- “I used it after each lesson to review what was done in class to get a better understanding of the material. The advantage is that you can refer back to the lecturer if you forgot something or additional explanation”.

The results from the blended courses are presented in Tables 1 and 2. In Table 1 one can see that the proportion of students accessing the online recordings is approximately even across both semesters, with roughly two-thirds of the class utilizing the recordings.

Table 1*Proportion of Students Accessing Online Recordings*

Access Recordings?	Fall 2010		Spring 2011	
	Yes	No	Yes	No
	69%	31%	65%	35%
Recordings used regularly after class to improve understanding	54%		60%	
Recordings used in order to catch up when missed class	46%		40%	

Table 2*Student Comments on Recorded Lectures*

	Fall 2010	Spring 2011	Sample Comments
Self-paced Regular use	12	7	Watching the recorded lectures was really easy, it was nice being able to fast forward through the lectures to find a part I really needed. Excellent learning method. It has helped me keep on top of things.
On Demand; used when needed	6	10	Nothing is the same as the actual classroom but it was helpful if I had to miss class.
Helped gain confidence in material	10	16	It helped me reinforce what I learned in class, and I used the recorded lectures to study as well.
Interactive	9	1	They are fun; Personal Tutor.

In Table 2, we have provided a broad classification for some of the free-form comments. One can see that the potential advantages of the recorded classes are (a) the ability to cater to different levels and needs (b) improves students' confidence in the material and (c) on demand lecture helps students catch up material they missed. The number of students using the recordings on a regular basis is higher in Spring 2011 than in Fall 2010. One reason for this might be that the instructor did not emphasize their presence in Fall 2010, whereas in Spring 2011, the instructor highlighted this facility on a regular basis. However, the total number of students using the facility either regularly or on a need to know basis is roughly the same.

We can conclude from this analysis that students in the blended group are using the recordings mainly as a method of re-enforcing and that the recordings are beneficial to the learning process, but not a critical component. This is not the case for the online group for whom the recordings represent an integral part of the learning experience.

Impact of Completing Online Homework

We now turn our attention to the electronic homework system. For each unit of the course, a number of homework problems were assigned via Blackboard's electronic test facility. The homework had to be completed by an assigned deadline. Once students submitted their homework results, they were able to observe their results. In this analysis we examine the impact of the homework component on the overall course grade when comparing the online group (Summer 2010) with the blended groups (Fall 2010 and Spring 2011).

In our earlier analysis (Orenstein, 2011) we found that the electronic homework system offered two benefits:

- students were cognizant of the impact of not doing the homework
- since the homework was graded automatically, instantaneous feedback was available.

In this paper we extend this question and consider if there was a difference between the online and the blended experience with respect to the correlation between average homework grade and course grade.

Consequently, for this study, we have used the identical course material and homework problems with the same weight in the overall course grade.

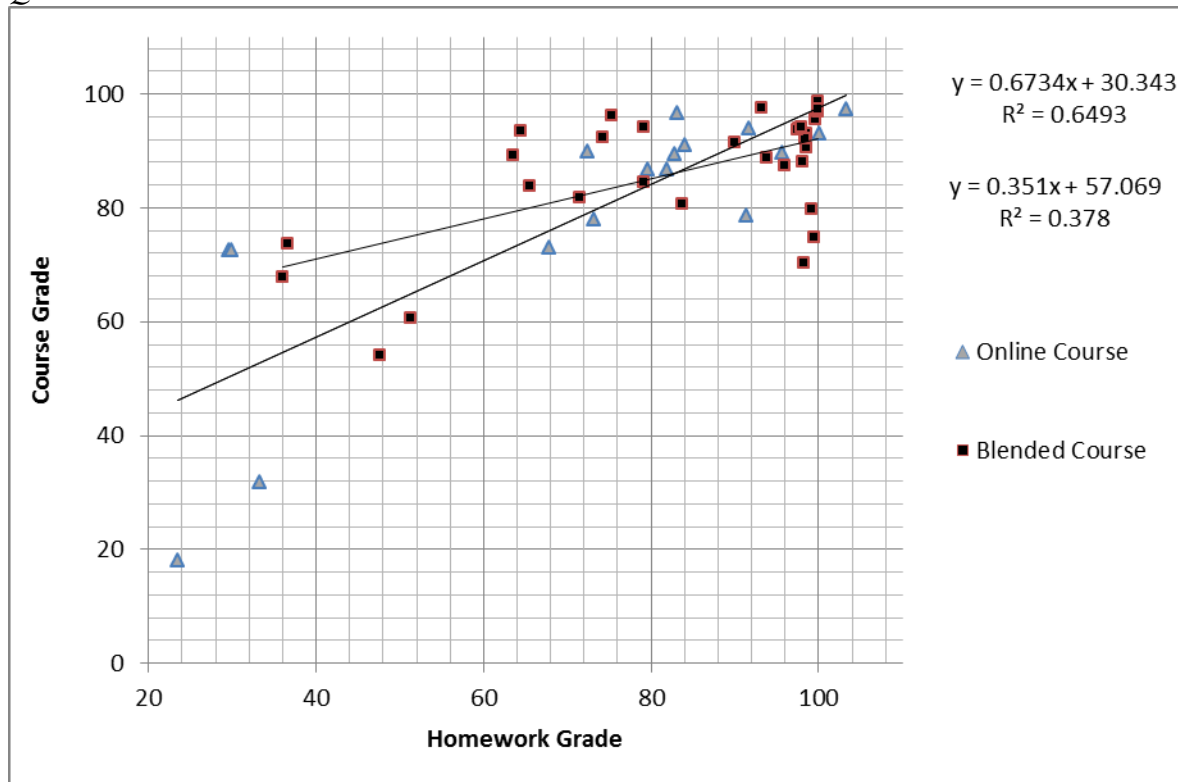
E-homework vs Course Grade. We have analyzed data sets from Fall 2010 and Spring 2011 for the blended course and from Summer 2010 for the online course experience. The main difference between the two types of courses is the face-to-face interaction that is present for the blended course and not for the online version.

For each data set, we have calculated the average homework grade and proportion of homework responses and compared this value with an adjusted course grade in which the homework component has been removed. This is to exclude the effect of the homework grade and to see only the indirect correlation of homework with course grade (based on everything except homework).

For both versions of the course there was strong correlation between homework grade and the overall course grade. The noticeable difference is the degree of correlation: for the online class it is higher than with the blended version. In fact, online course results had a 65% correlation, whereas for the blended course the correlation was 38% in Spring 2011, 48% for Fall 2010 section AA and 38% for Fall 2010 section AB. This suggests that the homework component is critical for students taking the online course whereas for the blended course, doing homework generally leads to better course grades but it is possible to obtain a favorable course grade even if homework grades are low. Note that the online results were obtained from a single group of students and a more detailed study needs to be conducted.

Figure 1

Correlation results between homework grade and course grade for the online vs. blended course in Quantitative Methods



Descriptive Statistics

We next consider descriptive statistics for a modified course grade in which the homework component was removed and compared this grade with the average homework grade. By removing the homework component, the effect of the homework grade itself is eliminated and we are left with the impact of actually doing homework and can evaluate its benefit.

Table 3 compares the averages and standard deviations of the final grades for a selection of sections of the course in chronological order.

One can see that for all sections considered (regardless of instruction mode) the average homework grade is approximately the same except for Spring 2011 in which the average is higher, but there is also less variability. The reason for this might be linked to the strong background of a large body of students in that particular class who as a cohort, consistently achieved high homework grades throughout the course. This can also be observed in the slightly favorable outcome in their final exam grade as compared with the other sections.

The results suggests that doing homework may slightly improve the final grade in the course, however the face-to-face interaction seems to be more significant in terms of the final course grade. In order to fully test this hypothesis, more evidence is needed for the online group.

Table 3*Descriptive statistics for impact of electronic homework on course grade*

	Mean	Min	Max	St Dev
Online Course				
Summer 10 HW	72	23	100	26.29
Summer 10 Course	79	18	97	21.98
Blended Course				
Fall 10 AA HW	72	9	100	31.19
Fall 10 AA Course	84	36	99	14.24
Fall 10 AB HW	72	4	100	28.93
Fall 10 AB Course	83	65	98	10.61
Spring 11 HW	83	36	100	19.89
Spring 11 Course	86	54	99	8.94

Conclusions and Further Work

The author described a hybrid approach in which two innovations were integrated into the classroom environment. These were (a) the use of non-intrusive recorded lectures to assist in the learning process when the skills of the students in the audience is non-uniform and (b) the use of electronic homework to re-enforce the material learnt in class and hence attain learning the course learning objectives. Both mechanisms were piloted at the undergraduate level for two modes of study: online vs. blended instruction. Students reported that when electronic recordings of the lectures were coupled with conventional classroom instruction, they were more successful in achieving the course learning goals because (a) they gained more confidence in the material and (b) found the self-paced instruction positive. In addition, students commented that the electronic lectures helped make the problems more interactive.

The results of our analysis can be summarized as follows:

- (a) For the online mode, students found the course intensive, fast paced and only the extremely dedicated and self-motivated students completed the course successfully. The recordings were found to be an *integral* part of the learning experience. For the blended mode, where recorded lectures were optional, students reported that the recordings enhanced their learning experience and improved their confidence in the material being mastered (learning outcomes), but were not critical to their progress. Recordings should therefore be instituted as an *active* component for the online course and a *passive* component for the blended course.
- (b) There was a correlation between the average homework grade and the final class grade. Students who performed well in the homework achieved the better grades, than their contemporaries who did not attempt the homework or who did little or no homework.
- (c) The homework component was critical for students taking the online course whereas for the blended course, doing homework generally led to better course grades but it was possible to obtain a favorable course grade even if homework grades were low.

- (d) Doing homework may slightly improve the final grade in the course, nevertheless, the face-to-face interaction in the blended course seemed to be a more significant factor in terms of the final course grade. In order to fully test this hypothesis, more empirical data is needed from the online group. This is a topic for future research.

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