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The effect of students' self-selection between the online and face-to-face on eLearning outcomes: a comparative analysis

**ABSTRACT**

The objective of this paper is to analyze the effect of students' self-selection of the instruction medium (online Vs face-to-face) on the eLearning outcomes. We find that the fail rates are significantly higher when students do not have an option to self-select between face-to-face and online sections. Given an option, students with higher abilities may choose online format over face-to-face and perform better. However, the eLearning outcome gets significantly affected when students have to enroll in an online section and cannot self-select between online and face-to-face sections.

**KEYWORDS:** eLearning, Self-selection, Online education, and Higher education

**INTRODUCTION**

The higher education is an information dominant industry. Varian and Shapiro (1999) essentially defined information goods as 'anything that can be digitized'. In the last couple of decades, the digitization of information-centric businesses has revolutionized many industries including movie, media, and publication. The information-oriented nature of the higher education stems from its mission. The primary mission of the higher education is to create and disseminate knowledge. The core activities through which such mission is accomplished are teaching and research, both heavily depend on information. The IBIS Capital report expects the size of the global education market to be around \$4.4 trillion (Strauss, 2013). So, it is not surprising that just like other information-centric industries, the Internet has become the most efficient platform for producing, distributing, and consuming the higher education related educational content (Peterson, Balasubramanian, and Bronnenberg, 1997; Pathak, 2016). The digitization of the higher education consists of a range of initiatives including the digitation of the course content, course websites, usage of the learning management systems (LMS) such as Canvas and Blackboard, online classes, hybrid classes, online degree programs, online tutoring services, micro lectures of Khan Academy, and even massively open online courses (MOOCS) (Pathak, 2015). eLearning or electronic learning is an essential part of the digitization of the higher education. In the context of instruction type or delivery mode, the courses are classified into three types: online, face-to-face, and hybrid. The face-to-face classes follow the traditional in-class synchronous teaching approach usually supplemented by the LMS. The online classes are mostly offered through the Internet (80% or more) and are usually asynchronous. The hybrid classes have become popular as they combine the benefits of synchronous face-to-face learning and asynchronous eLearning. Majority of universities have started offering face-to-face, online, and hybrid versions of different courses. Many researchers have studied how student performance differs by different instructional modes. Here, the student performance for learning is assessed by individual exam scores, performance in class assignments and quizzes, and overall course grade (Lack, 2013). There is no consensus on which format is better. According to a research based on a meta-analysis of eLearning studies between 1996 and 2008 (Means, Toyama, Murphy, Bakia, and Jones, 2009), the hybrid format performs significantly better than the face-to-face learning alone. This study also concludes that the online format alone does not offer significant performance advantages over the face-to-face format.

One of the limitations of prior studies is that they have not accounted for the self-selection factor. In many of the previous studies, the students choose the course delivery format of teaching (online, face-to-face, or hybrid) based on their abilities to perform better in that format. One of the prior studies found that students with higher perceived ability or wellness were more likely to be enrolled in online or hybrid course formats (Milroy et al. 2013)

The objective of this paper is to analyze the student eLearning performance in online and face-to-face sections of the core business course in the same semester. One section was in-class and the other two were offered online. One of the online course sections was offered during the regular registration period along with the other face-to-face section. Hence, the enrolling students may have selected the mode of education (i.e. face-to-face versus online) based on their ability to perform better in that mode of instruction. The second online section was opened very late and at that time, the enrolling students did not have a choice to select the mode of instruction. Thus, self-selection issue was not present for the students enrolling in the second online section. This unique situation allows us to investigate how students' performance differs between the online and face-to-face courses with or without the self-selection factor.

The rest of the paper is organized as follows. Section 2 provides the brief literature review on different eLearning models, current research on the effectiveness of eLearning, and self-selection issues in this stream of research. Section 3 summarizes how we have collected data for this research and analyzes the student performance in the online and face-to-face sections and finally, the section 4 concludes the paper.

## LITERATURE REVIEW

The digitization of the higher education has created significant changes in different academic institutions. At the course level, different instructional delivery formats: online, hybrid, and face-to-face have been implemented. Universities have also started offering online degree programs. Pathak (2016) has concluded that the digitization of the higher education may result in different educational models. This includes online education marketplaces (OEM), online education providers (OEP), and online education services (OES). OEMs provide tools and services to connect educational institutes and community of global learners to deliver online courses. MOOCs are the popular examples of OEM. Unlike OEMs, OEPs spend substantial resources in designing and developing proprietary educational material. The examples of OEPs include Khan Academy and University of Phoenix. Apart from teaching and learning, traditional universities also offer a range of educational services including mentoring, career counseling, advising, proctoring, and assessment. OES offers such complementary educational services to both OEMs and OEPs. eLearning is at the core of these emerging online educational models. Massively open online courses or MOOCs are the other popular educational business models. MOOCs are free and open access courses available without any spatial or temporal barriers. Sebastian Thrun and Peter Norvig of Stanford University developed the first MOOC in 2011, when they offered an artificial intelligence course to more than 150,000 online registrants (Pappano, 2012). Top three MOOC providers include edX (founded by MIT and Harvard University) and for profit Coursera and Udacity. The primary course delivery format in these MOOCs is online.

While not all the universities have started offering the MOOC type of courses, the majority of them have been offering courses in multiple delivery formats including face-to-face, hybrid, and online. The effectiveness of learning through these different modes has become an important

area of research and prior researchers have compared the effectiveness of eLearning in the online and hybrid formats with the traditional learning through face-to-face format. Many researchers have studied how student performance differs by different instructional modes. Here, the student performance for learning is assessed by individual exam scores, performance in class assignments and quizzes, and overall course grade (Lack, 2013). There is no clear consensus on which format is better. According to a research based on a meta-analysis of eLearning studies between 1996 and 2008 (Means, Toyama, Murphy, Bakia, and Jones, 2009), the hybrid format performs significantly better than the face-to-face learning alone. This study also concludes that online format alone does not offer significant performance advantages over face-to-face format.

Not accounting for the heterogeneity of the students and their preferences is one of the major limitations of the prior research. Milroy et al. (2013) found that the students with higher perceived wellness (i.e. abilities) were more likely to be enrolled in online or hybrid courses. This factor is known as self-selection. If students with the higher abilities self-select an online mode of instruction over the face-to-face format then their performance is superior not necessarily because of the online mode but because of their intrinsic abilities. Many prior researchers have discussed that eLearning may not be suitable for all group of learners because students are heterogeneous in their learning styles and abilities (Dunn et al. 2002). They demonstrate that high-achievers equally regardless of the teaching format, but low-achievers perform worse in hybrid format (Joyce et al. 2014). Even the factors such as class-size matter for those students as the performance is affected negatively as the class size increases. Other researchers have shown that lower-achieving, male, and Hispanic students perform better in face-to-face format (Figlio et al. 2010) and eLearning is ineffective for the community college students (Xu and Jaggars 2014). Wu (2015) provides summary of the latest research comparing eLearning effectiveness in different formats. Thus, it is important that the student heterogeneity driven self-selection is accounted for when we compare the eLearning effectiveness between different formats.

## **DATA AND ANALYSIS**

The data for this research have been collected from the multiple sections of the undergraduate business core course – Management of Information Systems (K321) in Spring 2016 semester. At the Leighton School of Business and Economics, we usually offer multiple sections of the core courses every semester. As a part of our strategy, one of the core sections is offered online every semester. Usually, for the spring semester, students can start registering for the course by the last week of October. Two sections of K321 were planned to be offered in spring 2016 and the student registration was opened from October last week. Students could self-select between an online (Web<sub>1</sub>) or face-to-face section (f2f) of K321 for Spring 2016. Once both the sections were full, an additional online section (Web<sub>2</sub>) was opened by mid-December. At this time, enrolling students did not have an option to self-select between face-to-face or online sections but had to select the online section of K321. Thus, in Spring 2016, we had three sections of K321: one face-to-face, two online. This provides us a unique opportunity to compare the effectiveness of face-to-face learning with that of eLearning both with and without self-selection.

K321 is a core business course and it covers both MIS concepts and hands-on problem solving skills using MS Excel and MS Access. At the time of regular registration period, 29 students enroll for face-to-face section and 41 students enroll for the online section. The maximum allowable enrollment for the face-to-face section and online section (Web<sub>1</sub>) was 30 and 40

respectively. The lower enrollment limit for the face-to-face class is because of the number of available computers in the computer lab. As shown in table 1, both face-to-face and Web<sub>1</sub> sections of K321 were full. For Web<sub>2</sub> section, the enrollment was 27.

	F2F	Web <sub>1</sub>	Web <sub>2</sub>
Teaching Format	Face-to-Face	Online	Online
Self-selection Option	Yes	Yes	No
Registration open	October (last week)	October (last week)	Mid-December
No. of Students	29	41	27

Table 2 provides the information about the student performance in these three K321 sections. As can be seen from the table 2, the average GPA for the Web<sub>1</sub> section of K321 is significantly higher than that of the Web<sub>2</sub> and face-to-face sections of K321. Students in the Web<sub>1</sub> section perform better in terms of the number of students receiving the letter grade As, Bs and DFWs (grade D, fail, and withdrawals). The Web<sub>2</sub> section has the worst DFW rate. More than 50 % of students from the face-to-face section of K321 received the letter grade C. It seems that these students who are more suitable for the synchronous learning have enrolled in the face-to-face section of K321 and have been able to receive the passing grade C. Likewise, more than 60% of students from the Web<sub>1</sub> section of K321 received grade B. These students with better perceived wellness or abilities have enrolled in the Web<sub>1</sub> section and have received satisfactory grades. The overall result of the self-selection is that the learning performance of the students has been satisfactory.

Grades	F2F	Web1	Web2
A	1	6	1
B	11	25	14
C	15	9	5
DFW Students	2	1	6
DFW Rate	6.89%	2.43%	23.08
Average GPA	2.31	2.83	2.34
Total Students	29	41	26

Table 2 also shows that in terms of the DFW rate, the students' performance in the Web<sub>2</sub> section of K321 is significantly worse. More than 20% of the students in the Web<sub>2</sub> section of K321 have received failing grades. At the time of enrollment, these students did not have an option to enroll in the face-to-face section of K321.

Grade	F2F	Web1	Web2
A	3.45%	14.63%	3.85%
B	37.93%	60.98%	53.85%
C	51.72%	21.95%	19.23%
DFW	6.89%	2.43%	23.08%
Total	100.00%	100.00%	100.00%

Table 3 provides the grade distribution in the percentage for the three K321 sections. In the Web<sub>2</sub> section of K321, more students received the failing grades (DFW) than those who

received the letter grade C. It is possible that given an option, some of these students might have enrolled in the face-to-face section which would have eventually reduced the DFW rate for the Web<sub>2</sub> section of K321. The absence of self-selection is affecting the students with the lower abilities more.

	F2F	Web <sub>1</sub>	Web <sub>2</sub>
Average Overall Total	77.74	82.63	77.52
St. Dev.	8.26	8.68	14.26
Final Exam	76.72	72.78	67.38
Second Exam	76.17	78.98	74.92
First Exam	78.41	88.17	77.65
Cases	87.48	94.22	86.81
Participation	86.21	89.29	89.92
Project	69.21	75.15	73.27

Table 4 provides the performance data for different grading components. As shown in the table, although the overall class average score for the face-to-face section and Web<sub>2</sub> section is same, the standard deviation of the overall score for the students in the Web<sub>2</sub> section is significantly higher. It seems that the face-to-face format would have helped some of the students in the Web<sub>2</sub> section significantly. The first exam for K321 was concept based, but the remaining exams had both concepts and hands-on components. The second exam required students to solve multiple problems using MS Excel and the third exam required students to work on MS Access database including forms, reports, and queries. All business students are required to take K201 – Introduction to Computers course before enrolling in K321. MS Excel and MS Access are covered extensively in K201. Post K201, students continue working on MS Excel in quite a few other business courses but they do not get an opportunity to work on MS Access further. This is reflected in the overall performance of the students in the second and third exam. In all three sections, students perform quite similarly in MS Excel-dominated second exam. However, both the online sections perform significantly lower in MS Access-dominated third exam. This shows that in the online sections, students with higher abilities may perform lower in some of the areas where significant skill reinforcement is required.

Figure 1, 2, and 3 show the grade distribution for the face-to-face, Web<sub>1</sub>, and Web<sub>2</sub> sections of K321 respectively.

Figure 1: K321 Grade Distribution for F2F Section

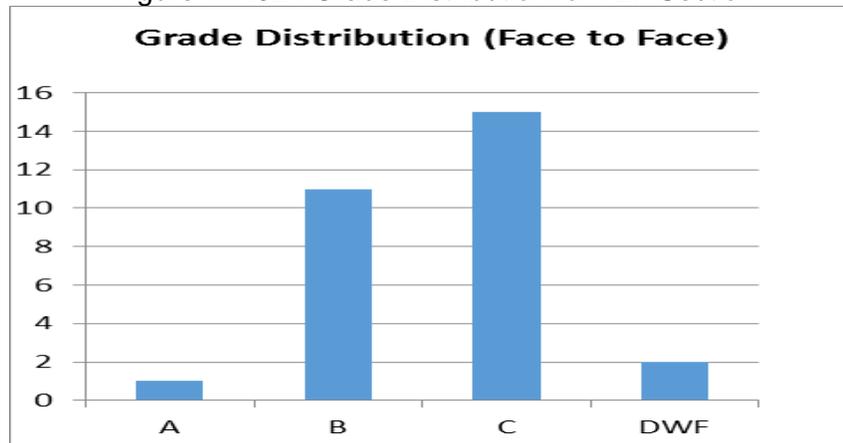
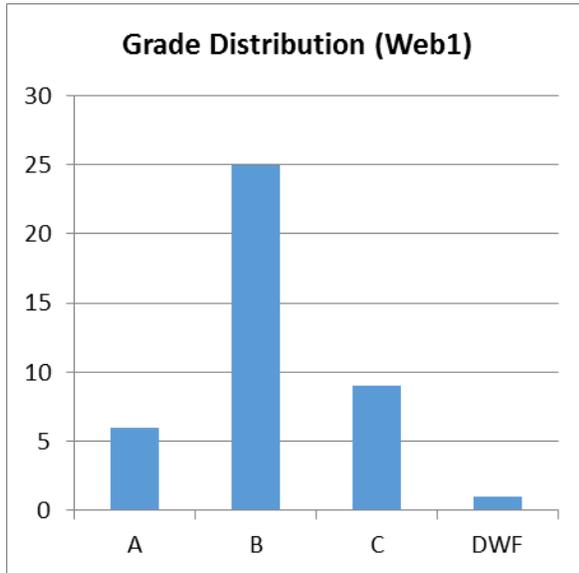
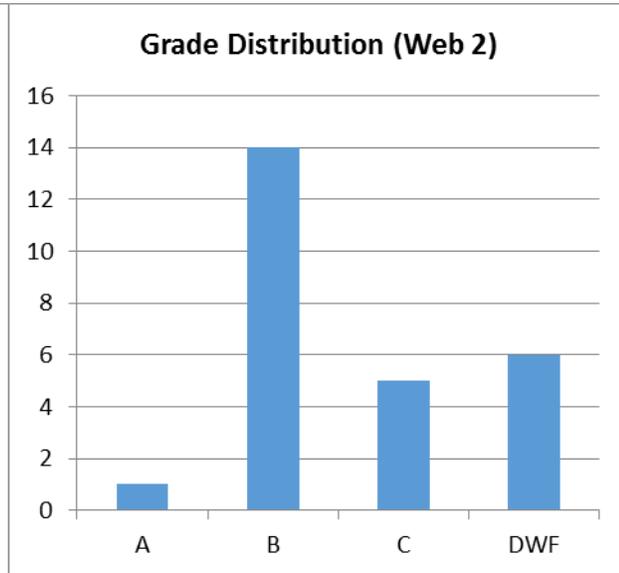


Figure 2: Grade Distribution in Web<sub>1</sub> SectionFigure 3: Grade Distribution in Web<sub>2</sub> Section

The charts clearly show the skewed performance of the students in the Web<sub>2</sub> section of the course.

## CONCLUSION

The research on the effectiveness of eLearning is primarily focused on comparing students' performance across different learning formats. In general, students are heterogeneous in their learning styles and requirements (Dunn, Beaudry, & Klavas, 2002). What works for one student may not work for the others. Prior researchers have shown how abilities, perceived wellness, and class size affect the effectiveness of eLearning.

We use a unique set of data to compare the performance of the students enrolled in three different sections of an undergraduate management information systems course. Two of these sections (face-to-face and Web<sub>1</sub>) were offered during regular registration period and hence students enrolling in these two sections did have a choice to select face-to-face or Web format. Once both the sections were full, the additional online section of K321 (Web<sub>2</sub>) was offered. Students enrolling in this section did not have an option to enroll in the face-to-face section unless they decide to delay taking this course by a semester. This creates a unique situation wherein we could study how self-selection affects the learning performance of the students. Students in the Web<sub>1</sub> and face-to-face sections perform significantly better than the students in the Web<sub>2</sub> section. This shows that students perform much better when they can select the learning format (i.e. online vs face-to-face) based on their perceived abilities. eLearning option alone may not be an effective learning for today's students with heterogeneous learning styles. In this research, we have not included student demographics and prior performance related data. Inclusion of this data may allow us to control for the other variables and analyze the effect of the mode of delivery on the student performance.

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