



Research Article

Open Educational Resources Adoption Reduces Textbook Costs without Sacrificing Student Performance in Business and Economics Courses at a Community College

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Abstract: This study analyzed the possibility of saving on textbook costs without sacrificing student performance by using Open Educational Resources (OER) at no cost to students as a replacement for high-priced commercially printed books. Approximately two hundred students enrolled in business and economics courses at Kingsborough Community College of the City University of New York from Fall 2016 to Fall 2018 were assessed in this study. Using summative assessments and course grades as a measure of students' performance, the findings showed that students in courses using OER as compared to students in the same subject area using traditional textbooks perform equally well. Therefore, OER materials that are available to students at no cost alleviate the higher costs that students incur for the purchase of traditional textbooks without a sacrifice or loss of student performance. These findings suggest that adopting open educational resources, even if no positive effect can be detected, can be used because they save students money on textbook costs, especially financially struggling students, without negatively affecting their learning and performance in the course.

Keywords: open educational resources (OER), open education, zero-textbook costs, OER benefits, access to education

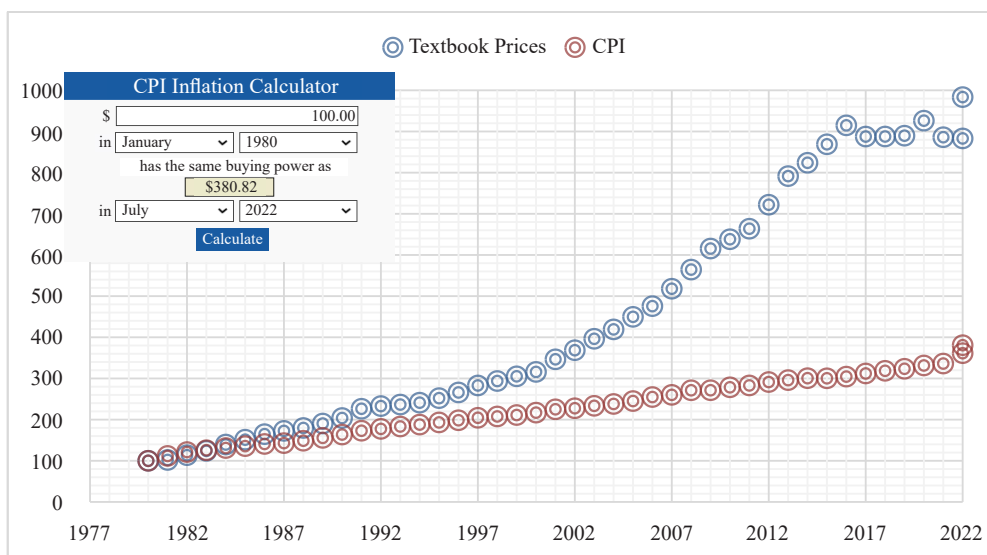
1. Introduction

Technology advances have notably affected every industry including higher education. This transformation evokes a full gamut of feelings ranging from the euphoria of being able to do things previously unthinkable, to the satisfaction of being more efficient, to the frustration of not knowing the new, and finally to the excitement of learning the new. One example is the decrease in costs, both fixed and variable, of creating, storing, and distributing educational materials in higher education. While the use of technology in education spans many topics, this study focused on the impact of using an online system to deliver open educational resources and textbooks at no cost to students and its effect on students' performance. When commercially printed textbooks are replaced with course content derived from open educational resources, there is a corresponding concern as to whether the quality, type, or style of the material will negatively impact student performance. This study inquired whether business and economics students in courses using open educational resources, accessed at no cost to the students, performed equally well when compared to students using traditional high-cost textbooks in the same subject area. A finding of no loss in students' performance between the use of traditional

textbooks and open educational resources would validate the benefits derived from the enormous cost differential.

2. Literature review

This study analyzed the benefits of a more affordable substitute for commercially printed textbooks given that costs of access have increased at an astronomical pace. The textbook cost index in 1980 was 100 compared to 983 in 2022 as shown in Figure 1. While textbook costs have increased on average ten-fold, the cost of living has quadrupled as calculated using the Consumer Price Index (CPI) during that same time. In other words, textbook costs have increased 2.6 times more than the cost of goods and services that a typical consumer purchases, as shown by the CPI. Furthermore, according to the data analysis in the report “Trends in College Pricing and Student Aid 2021”, the income of the lowest quantile families has experienced a slower increase compared to the top quantile families during the same time, years 1980 through 2022 as shown in Figure 2. This data illustrates a very gloomy reality that departs from our desired notions of equity and fairness in a higher educational setting. While textbook costs increased relatively more than inflation and more than the cost of other consumer goods, the income of lower quantile families increased only by 17%. When income does not keep up with increasing costs, it is not surprising that students struggle with textbook costs and, sometimes, forgo buying them and instead choose other substitutes, such as food and rent.



Note: The graph has been prepared using the data from the CPI Inflation Calculator of the Bureau of Labor Statistics (BLS) (2022) and BLS data source on PCU511130511130F21 for college textbook costs. <https://download.bls.gov/pub/time.series/pc/pc.data.53.Publishing>

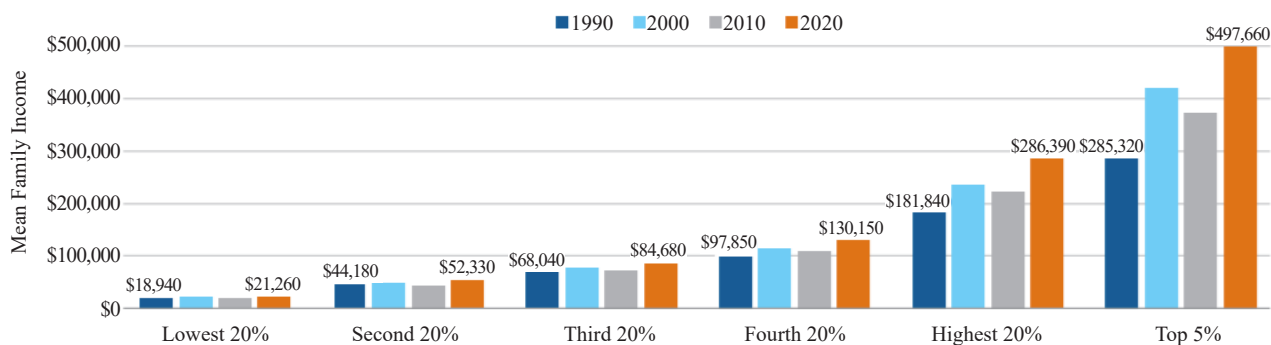
Figure 1. College textbook costs index from 1980 to 2022

These data confirm the ongoing and intensifying struggle of students to meet rising college costs, including textbooks. Food insecurity is an additional factor that exacerbates this situation (Haskett et al., 2020). To help alleviate these burdens, OER have become widely used as a replacement for high-priced commercially printed textbooks. The main goal is to alleviate the high costs of textbooks and provide students with equal opportunities to access course materials (Wright et al., 2020).

OER are defined by the Creative Commons as “...teaching, learning, and research materials that are either (a) in the public domain or (b) licensed in a manner that provides everyone with free and perpetual permission to engage in the 5R activities-retaining, remixing, revising, reusing, and redistributing the resources” (2021). OER have been used to substitute high-cost commercially printed textbooks to improve students’ access to textbooks. According to Falk (2020), OpenStax reported in August 2020 an approximate textbook cost savings of \$1 billion because of OpenStax textbooks used by over fourteen million students from 2012 to 2020. Furthermore, results of a study gathering students’

perceptions from anonymous surveys administered to over 500,000 students across 83 campuses and 19 states and Washington DC, indicated a negative impact of highly-priced course textbooks (Nagle & Vitez, 2020). In that study, 11% of the respondents reported skipping meals to purchase a textbook. Additionally, 63% of the respondents in that same study reported skipping the purchase of textbooks and substituting textbook costs with competing goods and services, such as food, utilities, etc. (Nagle & Vitez, 2020).

FIGURE CP-15A Mean Family Income in 2020 Dollars by Quintile, 1990, 2000, 2010, and 2020



Note: Figure 2 is retrieved from “Trends in College Pricing and Student Aid 2021,” (Ma & Pender, 2021) showing that the mean income increased by 12% for the lowest quintile of families and 57% for the top quintile of families during 1990 and 2020

Figure 2. Individual demands and supplies derived using the induced values and costs

Hence, the use of OER materials as a replacement for high-cost commercially printed textbooks substantially helps decrease costs associated with college courses and provides students with a more equitable position in accessing the course material. While the financial cost benefits are measurable, the next question is whether such a replacement has any positive or negative impact on students’ academic performance. Students’ perceptions of the quality of the OER material have been consistently positive. For example, Illowsky et al. (2016) and Abramovich and McBride (2018) found that over 85% of the students who responded to the surveys reported their impression of OER quality to be better or the same as traditional textbooks. Similarly, Cooney (2017) found that 96% of the students and Ikahihifo et al. (2017) found that 94% of the students considered the OER quality no worse than commercially printed textbooks. Faculty perception of OER quality is similar. For example, Bliss et al. (2013a; 2013b) found that 90% of the participating faculty believed that the availability of OER material is the same or better than traditional textbooks. Allen and Seaman (2014) found this rate to be slightly lower at 87.8%, but it is still highly indicative of the perception of OER as a good quality substitute.

A more recent study by Grimaldi et al. (2019) provides an explanation as to why many OER studies show a null effect on learning. They argue that most of the educational studies on OER adoption are functionally limited because they fail to consider the textbook access rates prior to the implementation of OER. The access hypothesis posited by Grimaldi et al. (2019) argues that OER adoption should be effective as a learning intervention because it ensures that all students have access to the textbook. However, since there are always students who would have access to the textbook anyway, the intervention would not be expected to isolate and capture the effect. Therefore, by including these students in the study population, argue Grimaldi et al. (2019), most traditional studies will effectively be washing out the positive effect of the intervention on those students who would not have textbook access otherwise. To resolve this design limitation, Grimaldi et al. (2019) conducted a series of simulated experiments showing that the higher the pre-adoption rate of textbook access, the more dramatically the power of the experiment decreases making it much harder to detect the positive effects of OER. This could also provide support as to why no statistically significant positive impact was found in this study when shifting from traditional textbooks to OER material. In line with the access hypothesis of Grimaldi et al. (2019), the reason for this finding could be that the control group, the ones that would benefit even without the intervention, were included in the performance of the full population. Therefore, the efficacy of OER on student performance could be understated. To further support an argument to use OER, even more significantly, the fact

that the results showed no adverse impact. If there are cost savings to replacing high-cost textbooks with OER and there are no losses, then OER adoption appears to be a rational choice.

The studies above reported a positive perception of OER as a good substitute in terms of quality. In addition, several empirical studies have also shown that the use of OER materials does not negatively affect students' actual academic performance. Starting with earlier studies of Wiley et al. (2012) and Hilton III et al. (2013), to more recent studies by Chiorescu (2017), Croteau (2017), Kelly and Rutherford (2017), Ozdemir and Hendricks (2017), Lawrence and Lester (2018), and Lovett et al. (2018), no statistical difference was found in student performance compared to students enrolled in non-OER material courses. Other researchers, such as Feldstein et al. (2012), Gil et al. (2013), Bowen et al. (2013), Hilton III and Laman (2012), Robinson et al. (2014), Wiley et al. (2017), and Grewe and Davis (2017), found evidence of positive effects of implementing OER in classes, including lower withdrawal rates. These studies did not find any statistically negative impact resulting from the use of OER material as a replacement for commercially printed textbooks. Falk (2020) argued that students can save on average \$300 per course while still receiving quality educational services and learning that leads to academic success.

The current study adds to these empirical studies by providing data and analysis of the use of OER in business and economics courses at a diverse university with 45 percent of students reporting an annual household income of less than \$20,000 during 2012 (City University of New York, 2012). A more recent survey shows that the portion of participating students enrolled in Kingsborough Community College who reported to have worried sometimes to always about not having enough money to pay for housing costs and food was 60 percent and 36 percent, respectively (City University of New York, 2018). This study analyzed whether using OER material that provides measurable financial savings to the students has any negative academic costs as measured by final exam grades and course grades. This study used data from students enrolled in Kingsborough Community College at the City University of New York between 2016 and 2018. The findings are in alignment with prior empirical studies in the field and, thereby, strengthens the case for the implementation of OER to provide free or low-cost course materials to college students, particularly in settings where access to textbooks is severely limited because of financial needs.

The hypothesis of this study was that the final exam and course grades of students would not change if students learned using course content derived from open educational resources at no or low cost to students ("experimental group or OER") as compared to traditional publisher textbooks ("control group or non-OER"). The findings from the data analyses collected from a sample of students at Kingsborough Community College show that such a null hypothesis is not rejected. The results indicate that there is no statistical difference in student performance between the OER and non-OER groups, implying that the type of textbook used would not negatively affect students' performance. Adopting OER does not hinder student performance, and at the same time, tremendously helps students financially due to the replacement of high costs books with zero-cost ones.

3. Materials and methods

To analyze whether there is any difference in student performance between courses that assign reading materials from various sources, statistical analyses were run in two groups: OER and non-OER. OER was an experimental group and includes students enrolled in courses that adopted OER textbooks and materials. The non-OER was the control group and included students enrolled in sections of the same courses taught by the same instructors but adopted traditional publisher books with costs varying from approximately \$100 to \$400. The data collection instruments used in this study were summative assessments, such as final exams and final grades. While final exam scores provide a clearer, but more isolated performance indicator since it is a score on a specific summative assessment, the course grades provide a more thorough reflection of students' learning throughout the semester.

Data were collected from several sections of Principles of Macroeconomics and Fundamentals of Business taught between Fall 2016 and Fall 2018 at one of the City University of New York's community colleges. Fundamentals of Business and Principles of Macroeconomics are core curriculum courses for most of the Department of Business Associate in Applied Science (AAS) program degrees at the Kingsborough Community College, and electives for several other majors. The reasons that these two courses were chosen were due to textbook prices, quantity, and quality. The textbook prices for these courses varied between approximately \$100 to 400 and are some of the highest-priced

college textbooks. For example, the Principles of Macroeconomics course used one of Mankiw's textbooks (2021), which is listed by the publisher at \$289.95 for hardcopy and \$435 per e-pack textbook with 1-term instant access MindTap. If these high-cost textbook courses adopt a free access OER textbook instead, it will alleviate students from a cost burden ranging from approximately \$300 to \$400. In addition to high and increasing textbook costs, students frequently complain to faculty about the unclear, difficult, and highly technical language used in this traditional textbook. While there was no quantitative analysis made on the quality of the textbook, it was clear to the faculty that students' perception of the traditional textbooks' quality was not fully satisfactory. Last, the two courses used in this study are required for most AAS business degrees and electives for other degrees, and therefore, provide a high sample size due to the high enrollment. Consequently, a switch to the adoption of OER material in these two courses, if shown to not have any negative impact on student performance, would most likely translate into higher cost-savings because it would affect many students.

The difference between the control and experimental groups for the various sections of the courses was the source of assigned course reading material. Those sections where faculty assigned a traditional textbook from well-known higher education publishers were designated as the control group (non-OER). Those sections where faculty assigned high-quality materials derived from open educational (OER) resources at no or low cost were designated as the experimental group.

The data were collected with the appropriate approvals and exemptions provided by the CUNY Institutional Review Board (IRB). The data were collected and decoded to eliminate any personal or sensitive information and provide complete anonymity. Questions related to race and gender were not asked. This was one of the limitations of the study because it did not allow for further disaggregation of the data. However, collecting detailed information in a small classroom could run the risk of participants' identification. While such limitation remained as such, the sample size increased through the use of many sections throughout three years.

This study contributes to the literature because it investigates a question that has been asked often as the use of OER has flourished in higher education. While similar studies have been implemented, the debate over the efficacy of OER has persisted. This requires additional studies to help make data-informed decisions about the future use of OER. Moreover, the current study contributes most significantly by adding critical data about a student population for which OER adoption might be most beneficial. This study is focused on community college students where students often face huge challenges to their success for various reasons, with financial challenges often at the top of the list.

4. Results

This study analyzed whether the selection of different sources of assigned course reading material, specifically high-cost traditional publisher textbooks ("non-OER") or zero cost textbooks ("OER"), would have any positive or negative effects on students' performance. Figure 3 shows that, overall, students in the control and experimental groups performed similarly, suggesting that replacing high-cost traditional publisher textbooks with zero-cost OER material would not negatively impact students' performance as measured by final exam and course grades.

The frequency of grades in OER and non-OER courses are about the same, but additional analyses were conducted to determine whether there is no statistical difference between these two samples, control and experimental. Table 1 shows the conversion of letter grades into a group letter, A through F, and scores 5 through 1. Students who withdrew from the course and received W (Withdrawal) or WU (Withdrawal Unofficially) scored 0 and were dropped from the data analysis. The reason for this exclusion is that W and WU grades could occur for a variety of reasons that might not have anything to do with the impact of the assigned reading material.

To determine whether there is any statistical difference between the experimental and control sample, we analyzed both results using the summative assessment scores (e.g., final exam) and course grades and applying a two-sample two-tail t-test. The null hypothesis that the average score of students enrolled in OER sections, known as the experimental group, and non-OER sections, known as the control group, is the same. Table 2 presents the findings of this ANOVA test showing high p-values. Using the evidence collected, the null hypothesis fails to be rejected and it is reasonable to conclude that students perform the same on their summative assessments, as well as in the overall course regardless of the assigned reading material compared in this study.

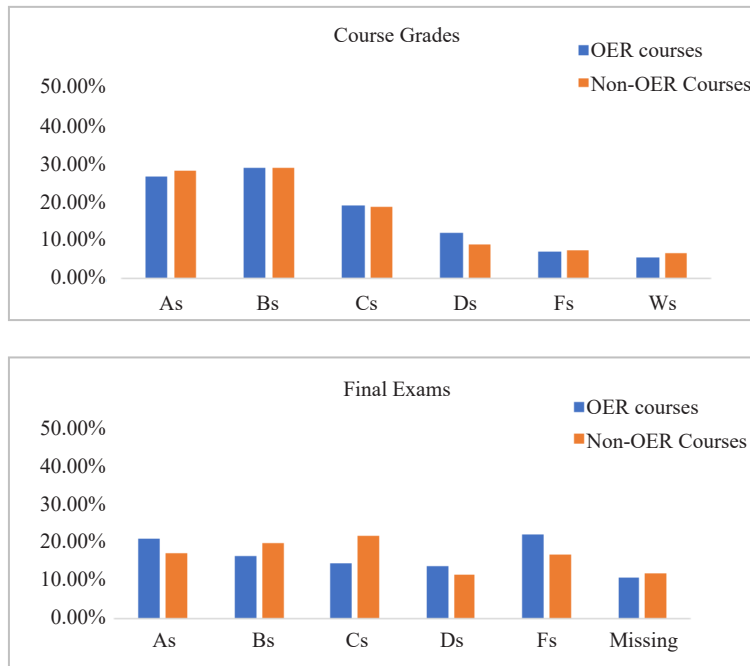


Figure 3. Grade frequency in control and experimental group: Final exams and final grades

Table 1. Grade conversion to likert scale

Letter grade	Letter Grade	Score
A+ A A-	A	5
B+ B B-	B	4
C+ C C-	C	3
D+ D D-	C	2
F	F	1
W	W	0

Table 2. Two sample two tail t-test results on control and experiment group by faculty & course

Variable	Observations	Mean	Variance	P
Course Grades - ECO 1200 Non-OER [Control Group]	81	3.63	1.66	
OER [Experiment Group]	37	3.95	1.61	< 0.22
Final Exam Grades - ECO 1200 Non-OER [Control Group]	72	3.33	1.97	
OER [Experiment Group]	34	3.59	2.07	< 0.39
Course Grades - BA 11 Non-OER [Control Group]	113	3.93	1.39	
OER [Experiment Group]	79	3.72	1.43	< 0.24
Final Exam Grades - BA 11 Non-OER [Control Group]	106	3.76	1.27	
OER [Experiment Group]	74	3.61	1.56	< 0.39

Table 2 shows the findings of 194 students enrolled in several sections of ECO 1200 or BA 1100 at CUNY Kingsborough Community College during the three-year review from Fall 2016 to Fall 2018. Since these were different courses and taught by different faculty the results were disaggregated by faculty and type of learning to isolate any subject or instructor bias. After running an ANOVA t-test, the findings show no statistical difference in academic success measured by summative assessment scores, such as a final exam, and course grades between the control and experiment groups. These same results radiate for all students, regardless of the type of textbook adoption.

5. Limitations and future discussions

The data are not disaggregated further by gender or other student characteristics. We assume that gender or any other student feature might not influence how students absorb and perform based on using the various sources of material, e.g., non-OER or OER. We also consider such data analysis, disaggregated by gender and/or demographics, as not actionable data. If we were to find any differences across gender or demographics, further analysis about the reasons why would be out of the scope of this article. For the purpose of this article, the findings showed that the use of OER materials did not negatively impact students' performance and supported the decision to incorporate OER materials in the course for the entire group of students, regardless of their gender and demographics. The analysis shows that student performance is not affected by the source of the assigned reading material. Since the return on benefits is the same, while the cost of using OER material is cheaper, in economic terms, then any rational person would adequately and efficiently choose to select the cheaper option for the same result.

These findings are valuable because they become another example of adopting OER without hindering students' performance. In addition to strengthening the support for adopting OER material, the next step would be how to improve such adoption. In future studies, it would be interesting to observe differences in sections adopting customized OER versus using off-the-shelf OER without modifications. When instructors curate and customize OER material to cater to the needs of the students, it would seem likely to improve student performance and learning experience as well as teaching experience. Confirming such expectations with data in future studies.

6. Conclusions

This study found that student performance was not negatively impacted by adopting OER textbook reading material. The data suggest that student performance remains the same whether students are assigned a textbook distributed through traditional higher education publishers or are assigned course content derived from open education resources at no or low cost to students. This study is particularly important at community colleges where students often face huge challenges to their success for various reasons, with financial challenges often at the top of the list. The findings of this study provide evidence and support that the use of OER, particularly in high-enrollment introductory courses at a diverse urban university where the financial need is great, does not negatively affect student performance while it might be difficult to know which students precisely the ones are benefiting from the use of OER. This study provides evidence from a diverse student body that adopting OER would provide cost savings and alleviate some of the financial burdens of attending college.

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Conflicts of interest

The authors declare no competing financial interest.

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