

Adoption of OER Materials for a College Algebra Course and Its Results

During the Spring 2016 semester, Southern Utah University (SUU) adopted an OER textbook for its general lower-division algebra course (Math 1050). Overall, the new adoption for the course went extremely well.

Background

The main interests in adopting OER materials at the college level are the impact of textbook prices on students and equitable access. Most OER materials are available to students and faculty in digital formats for free and in print for the cost of printing. The OER textbook SUU adopted for Spring 2016 was *College Algebra & Trigonometry* by Abramson, et al. published through OpenStax. With this textbook, students have the options to download a free digital copy from the textbook's website or purchase a new physical copy for \$58 from Amazon.com. In contrast, the commercial textbook used prior to the OER textbook (*College Algebra*, 9th Ed. by Sullivan [Pearson]) cost \$174.93 for a digital copy and \$218.07 for a new physical textbook.¹ In addition to saving students money, OER materials grant students, especially disadvantaged students, more access to their learning materials beginning on the first day of class.

Existing Research

A traditional market-based argument against OER materials is that lower pricing implies lower quality. I do not feel that argument is merited, as studies have shown student performance does not decrease when OER materials are used. In fact, the research indicates that student performance might actually increase with OER materials.² The experience SUU had teaching Math 1050 with OER materials reflects the same student success that the research indicates. There was a large increase in student completion in the course, with an 86.4% reduction in the number of students receiving an unofficial withdrawal (UW) grade,³ and there was also a slight improvement in test scores. Controlling for other variables, all other important trackers for student learning were essentially the same as for sections using the commercial textbook.

Southern Utah University's Study

The sections of Math 1050 that used OER materials in Spring 2016 were sections 02 and 08, which had 48 and 15 students enrolled respectively. These will be known as the

"OER sections." Four sections of Math 1050 taught by the same professor, but using the commercial textbook, were sections 01 and 04 in Fall 2014 and sections 03 and 08 in Spring 2015, which had 45, 34, 33, and 26 students enrolled respectively. These will be known as the "non-OER sections" and are used as the control group for statistical comparison.

At the end of each semester, all students were asked to complete a student evaluation survey summarizing the strengths and weaknesses of the Math 1050 course and instructor. The averages reported here only include those students who completed the course. Table 1 contains the students' average response to overall evaluation of the whole semester, excellence of teacher, and excellence of course. The ratings are on a 5-point scale, with 5 being the best and 1 being the worst. Considering the weighted averages between the OER and non-OER sections below, we see that the student evaluations reflect about the same quality of instruction.

Section	Number of Responses	Summary Evaluation	Excellent Teacher	Excellent Course
Spring 2016-02	44	4.0	4.0	3.8
Spring 2016-08	12	4.6	4.8	4.6
OER	56	4.13	4.17	3.97
Fall 2014-01	28	3.7	3.9	3.4
Fall 2014-04	20	4.3	4.7	4.0
Spring 2015-03	19	4.4	4.6	4.3
Spring 2015-08	20	4.6	4.8	4.6
Non-OER	87	4.20	4.44	4.01

Table 1. Student evaluation of course quality.

Table 2 displays more data from the same survey. On the next three items, students were asked to compare their Math 1050 course with other courses they have taken at SUU using the scale 1 = Much Less Than Most Courses,

¹ The prices for the Sullivan text are actually for the tenth edition of this text, since the ninth edition is no longer available for purchase new in print or digitally. Publication of the newer edition was the reason that we considered adopting a new textbook for this course. Unsurprisingly, the tenth edition was not significantly different from the ninth edition, yet the scarcity of used copies of the tenth edition made it much more expensive than the ninth edition.
² Jon McBride, "Students who switch to open source textbooks don't see grades drop," *BYU News*, 19 October 2015, <https://news.byu.edu/news/students-who-switch-open-source-textbooks-dont-see-grades-drop>, cited online 16 August 2016; "At Salt Lake Community College, Math Students Score Higher Using Open Educational Resources," <http://lumenlearning.com/success-story-slcc/>, cited online 16 August 2016.
³ A grade of UW is given to students enrolled in a course students enrolled in a course who, for whatever reason, stop participating and fail to complete the work.

2 = Less Than Most Courses, 3 = About Average, 4 = More Than Most Courses, and 5 = Much More Than Most Courses. Again, considering the weighted averages between the OER and non-OER sections below, we see that the student evaluations reflect about the same rigor of instruction.

Section	Amount of reading	Amount of work in other (non-reading) assignments	Difficulty of subject matter	Excellent Course
Spring 2016-02	2.3	4.2	3.8	3.8
Spring 2016-08	3.4	3.9	3.5	4.6
OER	2.54	4.14	3.74	3.97
Fall 2014-01	2.7	4.3	4.2	3.4
Fall 2014-04	2.2	4.3	3.7	4.0
Spring 2015-03	2.5	4.2	3.9	4.3
Spring 2015-08	3.0	4.0	4.0	4.6
Non-OER	2.61	4.21	3.97	4.01

Table 2. Student evaluation of course difficulty.

Math 1050 has four exams distributed throughout the semester and a final comprehensive exam at the term's end. The weighted averages for each of these exams for students who completed the course are presented in table 3. Mostly these averages are about the same, although the OER sections did a little better on Exam 3 and a little worse on the Final Exam. On the surface, the drop in the Final Exam average seems like a cause for alarm, but that drop is probably a consequence of a much lower UW rate, later addressed in Table 5.

Section	Exam 1	Exam 2	Exam 3	Exam 4	Final Exam
OER	79.4%	75.5%	74.6%	73.34%	68.21%
Non-OER	77.7%	75.3%	68.8%	72.2%	72.0%

Table 3. Exam averages for students who took the exam.

Finally, Table 4 presents the percentages of students who passed the course with a grade of C or higher. The most striking outcome is the 15-percentage-point gain in the pass rate (the percentage of students who receive a grade of A, B, or C) in the OER sections. Significantly, the number of students receiving a B increased by 9.88 percentage points and the number of students receiving a C increased by 3.33 percentage points compared to the sections using the commercial textbook.

Section	% of As	% of Bs	% of Cs	Passing	Final Exam
OER	27.87%	37.70%	19.67%	85.24%	68.21%
Non-OER	26.32%	27.82%	16.54%	70.68%	72.0%

Table 4. Student pass rates.

Just as significant as the pass rate is the fail rate, or the percentage of students receiving a grade of D, F, or UW. The fail rate for the OER sections was 14.75% and for non-OER sections, 29.3%. Thus, the OER sections had a 15-percentage-point drop in the fail rate matched by a 15-percentage-point increase in the pass rate. When focusing on only those students receiving a grade of UW, the difference in the rate between OER and non-OER sections is substantial. The UW rate for the OER sections is 1.64%, and 12.03% in non-OER sections. This indicates that students in the OER sections were much more likely to complete the course.

The large decrease in UWs probably explains the lower Final Exam average for the OER sections in Table 3. This is because more students took the Final Exam who otherwise might not have taken it and subsequently been assigned a score of zero. As a result of more students willingly taking the Final Exam in OER sections, there were less zero scores eliminated and so a larger pool of above-zero scores considered in the exam average. Table 5 presents Final Exam averages again, but this time includes all scores, including zeros, for students enrolled in the course.

Section	Exam 1	Exam 2	Exam 3	Exam 4	Final Exam
OER	78.21%	74.29%	72.17%	67.33%	64.85%
non-OER	75.45%	70.83%	64.11%	59.25%	63.79%

Table 5. Exam averages for all students enrolled in studied sections.

Comparing the differences in exam averages between OER and non-OER sections with zeros included demonstrates a larger gap in exams averages as the semester progresses. This is likely because more students persevered until the end of the course in OER sections.

Conclusion

Beyond the clear financial benefits of OER materials for students, SUU's case study found that perceptions and course outcomes slightly improved with the implementation of OER and that the retention rates for the OER sections were significantly higher than those with commercial textbooks. This suggests the conclusion, which is also supported by other literature, that the use of Open Educational Resources can lead to better student performance.

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