

Redesigning a Research Methods Course with Personalized, Interactive OER: A Case Study of Student Perceptions and Performance

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Abstract: This case study examines student learning outcomes derived from the redesign of an undergraduate child development research methods course, replacing a commercial textbook with Open Educational Resources (OER), which were remixed into interactive lessons. Using survey and exam performance data, two areas were evaluated: 1) students' experiences with the OER lessons; and (2) students' exam results from two OER sections compared to two previous commercial textbook sections taught by the same instructor. No significant differences in exam performance between the two groups were observed; however, student perceptions of the OER lessons indicated strong satisfaction. Implications of these findings, such as OER benefits for teaching and learning, are discussed.

Keywords: college students, Open Educational Resources (OER), student perceptions, student achievement.

In the last decade, higher education institutions across the United States have been significantly invested in improving accessibility to college and increasing degree completion rates, while also narrowing achievement gaps among traditionally underrepresented students. One solution that has garnered recent attention in aiding student success is the use of Open Educational Resources (OER), due to their potential to make course materials affordable and accessible to all students. Recent years have seen a dramatic increase of OER awareness and use in higher education (Seaman & Seaman, 2018).

Open Educational Resources (OER) Benefits

OER are freely accessible, openly licensed documents and media that are useful for teaching, learning, and assessing (Hewlett, 2013). It is well established in the literature that one of the primary benefits of OER is cost savings for students (e.g., Bliss, Hilton, Wiley, & Thanos, 2013; de los Arcos, Farrow, Perryman, Pitt, & Weller, 2014; Farrow et al., 2015; Fischer et al., 2015; Watson, Domizi, & Clouser, 2017). Studies show that the cost of course materials can have a negative effect on student retention, and that even a few hundred dollars spent on textbooks can mean the difference between a student dropping out or staying in college (de los Arcos et al., 2014; Fischer, Belikov, Ikahihifo, Hilton, Wiley, & Martin, 2020; Senack, 2014). Each academic year, students may spend as much as \$1300 on textbooks alone (College Board, n.d.). Moreover, college textbook prices have risen 1,041% since 1977, which greatly surpasses the rate of inflation during the same period (Popken, 2015). With textbooks expenses on the continued rise, it is no surprise that many students (65%) have reported going without their required college textbook simply because of cost, even though the majority of students believe it will negatively affect their grade (Fischer et al., 2020; Senack, 2014).

Current research has also highlighted OER as a social justice issue, identifying the affordability of textbooks as a more significant barrier for students from historically underserved backgrounds (Jenkins et al., 2020). In fact, some studies show that the affordability of OER textbooks can effectively promote college completion for students who are at-risk of leaving college due to financial

difficulties (de los Arcos et al., 2014; Winitzky-Stephens & Pickavance, 2017). In addition to lowering the cost of higher education for students, OER can positively impact student success in other ways. If students have access to free OER instructional materials that are immediately available on the first day of their classes, they may be less likely to drop out for financial reasons and more likely to be successful in their courses. A majority of students not only report preferring OER over commercial textbooks (Jhangiani & Jhangiani, 2017; Hendricks, Reinsberg, & Rieger, 2017; Watson et al., 2017), but also identify OER as saving them significant money, improving their satisfaction, and having a positive impact on course completion (Bliss et al., 2013; de los Arcos et al., 2014; Griffiths et al., 2020; Jhangiani & Jhangiani, 2017; Watson et al., 2017).

Instructors have expressed concerns about the efficacy and quality of OER materials, with some fearing that free materials might be lower in quality or depth of content (Kahle, 2008). However, higher education faculty have rated the quality of OER as equivalent or better than traditional resources (Allen & Seaman, 2014; Bliss et al., 2013). Other faculty concerns such as copyright issues and sustainability (Martin & Kimmons, 2020) can be easily addressed by with the support of librarians who can assist faculty in choosing OER options that best fit their needs (Fischer et al., 2020). Curated and peer-reviewed platforms and repositories can also aid faculty in searching for materials that are reliable and high in quality (Van Allen & Katz, 2020). Additionally, many non-profit, large OER producing, organizations like [OpenStax](#) follow an editorial process similar to that of commercial textbook publishers which involves OER written by qualified instructors teaching in the field and a thorough peer-review process.

To further allay faculty concerns about the quality of OER, recent meta-analyses (Clinton & Khan, 2019; Hilton, 2020) have underscored the relationship of OER with positive student experiences and complementary achievement outcomes. Hilton's (2020) synthesis of 36 studies relating to efficacy and perceptions revealed a consistent pattern of faculty and student satisfaction with OER while also suggesting similar or better learning outcomes for courses using OER. Clinton and Khan's (2019) systematic analysis of 22 studies reported no significant difference in student learning performance between courses with open textbooks compared to those with commercial textbooks; however, they noted that withdrawal rates were reliably lower for open textbook courses. A study conducted as part of the Achieving the Dream's OER Degree Initiative suggests that students from the 11 participating colleges who took multiple OER courses completed more college credits and had equivalent cumulative GPAs on average compared to students who took no OER courses (Griffiths et al., 2020).

Personalization of OER

One of the significant benefits of OER for student success that is often overlooked is its customizability. Because OER are openly licensed, faculty can reuse, remix, and change materials to ensure up-to-date, inclusive, and personalized content that is delivered in alternative, more engaging ways than traditional textbooks (e.g., interactive elements, animations). The power of OER for faculty lies in their adaptability: faculty can personalize OER given the Creative Commons license permissions that let faculty adapt and remix OER resources to create content that is appropriate for their curriculum and student needs (Van Allen & Katz, 2020). Faculty can integrate current research and media into OER to ensure its timeliness, as well as provide additional information and visuals to the OER to create materials. These supplemental components can be personalized for their students' learning needs and improve the representation of diverse cultures. Van Allen and Katz (2020) concur that OER content allows for "greater cultural inclusivity than commercial materials" and "also foster(s) greater equity for accessing content for those with limited background knowledge" (p. 6). Moreover, faculty can redesign OER into more interactive experiences for students than a traditional

hard copy textbook by placing the OER content into software platforms that integrate content with videos, quiz items, and other types of self-check activities (Van Allen & Katz, 2020).

Research investigating faculty experiences with using OER report that most instructors identify making some pedagogical changes in their teaching to increase the relevance of their course materials and some of them also state that using OER gave students a more active role in their own learning (Griffiths et al., 2020). Several studies of customized OER have found that students' positive responses to these redesigned features lead to more positive course outcomes by sustaining their engagement and interest in the materials (Eichelberger & Ngo, 2020; Mathew & Kashyup, 2019). For example, Eichelberger and Ngo (2020) redesigned a Biology course using a customized OER textbook with embedded quizzes, digital glossary flashcards, and other interactive features. They found that these redesigned textbook customizations were reported to be students' favorite aspects of the text and that students rated the quiz and glossary features to be beneficial to their learning and understanding of the material. Although such features can also be found in commercial textbooks, students also respond positively to the ways in which customized OER can include more up-to-date examples and personalized content. When Hilton et al. (2019) probed student perceptions of experiences with open vs. traditional pedagogy, they found that the majority of students preferred open resources and cited increased knowledge, relevance, and personalization as their top reasons for this preference.

Current Case Study

The need for free instructional materials that are digitally accessible for all students has become magnified with the sudden transition of higher education to online modalities during the COVID-19 pandemic of 2020. The affordability and adaptability benefits of OER provide college institutions with a means to provide more equitable access to learning materials that are designed for student success through personalized, inclusive, and interactive customizations that engage students in active learning.

Hilton's (2020) review of the OER efficacy and perception literature revealed several weaknesses of research in the field: lack of control of both student and teacher variables and the use of nonstandard measurements of student learning. The purpose of the present case study is to investigate student perceptions and achievement of a redesigned social science research methods course that replaced a commercial textbook with OER, while minimizing instructor and exam variability. Although student variables could not be controlled with randomization, the instructor effects were controlled or minimized by examining course sections of the same research methods course taught by the same instructor, first with a commercial textbook, and then with OER. Moreover, consistent measures of student learning were used by keeping all exams constant across the pre-OER and OER course sections. In addition to the quantitative comparisons of student performance, this case study also provides an analysis of student perceptions of OER by presenting results from a survey of student satisfaction with elements of the OER redesign and a qualitative analysis of responses to open-ended feedback questions.

Method

Institutional Setting

The setting of this case study is a large, public university on the west coast of the United States with a diverse racial student population (approximately 40% Hispanic/Latina, 20% Asian, 20% white). Results from a campus survey completed by almost 10,000 students during the fall of 2016 determined

that only 28% reported buying all their required textbook/instructional materials every semester. Of those surveyed, 82% said the reason why they did not buy or rent required course materials was because they were too expensive; 41% of these students agreed that not obtaining their required course materials negatively impacted their learning. Thus, the university currently offers professional development for its faculty to learn about OER and how it supports student success (e.g., improving retention and graduation rates).

Course Redesign and Participants

The course that was redesigned was a foundational 3-unit, upper division research methods course required for all students in a child development major. The course learning outcomes focus on conducting library research, reading, dissecting, and synthesizing scholarly journal articles, using descriptive and inferential statistics, developing computer literacy, and exploring methods used in the scientific study of child development; the course culminates in an APA-research paper written individually by each student but based on a study conducted as a class. The original textbook was a department-chosen commercial textbook and the instructor also required an online quiz system that came packaged with the e-textbook (for a small additional cost, students could purchase a hard copy of the textbook). For the course redesign, a primary OER textbook was chosen ([Research Methods in Psychology](#)). The instructor used [SoftChalk](#) to create weekly online “interactive” lessons that consisted of a remix of content from the primary OER textbook and several openly licensed research method resources, in addition to some original examples and self-check items. Each lesson included text, visuals/graphics, and self-check items, in addition to including short video clips from YouTube or similar repositories in at least half the lessons. To ensure students completed the weekly online lesson(s), each had quiz scores that factored into the students’ grades; however, students were permitted to retake them as many times as they liked to earn higher scores. In the textbook sections, the online quiz system had been used in a similar fashion by assigning weekly due dates for chapter quizzes; the online system was slightly different in that it was adaptive, meaning students could earn 100% by completing more questions that were like the ones they missed. Thus, overall, the incorporation of the self-quiz items into the OER chapters was designed to be an equivalent to the online textbook quiz system, yet the cost was \$0 instead of the approximately \$100 for the commercial textbook with its online system.

There were 48 students (85% female) enrolled in the textbook group in the 2016 spring semester (24 students in each of two sections). A total of 34 students (94% female) were in the OER group (23 students in the 2018 spring semester and 14 students in the 2019 spring semester). All four course sections had the same instructor. However, the format of the sections was slightly different. In the textbook sections, the class met twice a week face-to-face, consisting of a two-hour lecture time and a two- and half-hour lab time; in the OER sections, the weekly two-hour lecture time was replaced by an online module that consisted of the OER interactive lessons and activities (which had been used in the face-to-face lecture time). The online module was designed to be equivalent in content and length to what was covered in the live, two-hour lecture time, so videos and examples shared in lecture were also shared in the online lesson. For all sections, the weekly two-and half-hour lab time consisted of hands-on activities, class discussions, and collaborative group work. Although all four sections had the same learning outcomes, the same instructor, and the same course exams, assignments were not held perfectly consistent across the sections because of the iterative nature of course improvement; the instructor attempts to improve course assignments each semester based on student feedback, thus minor revisions of the assignments happened each semester the course was taught.

Measures/Materials

To assess student performance, all sections (textbook and OER) were given the same three course exams. A standardized department final was also administered to all sections; the department has two versions equivalent in format and points, which are randomly assigned to all research method course sections.

Students in the OER group were given a survey to assess their perceptions of the OER lessons. The survey was administered twice (mid-semester and end of semester). Using the learning management system, the survey was administered anonymously, but students were given one point of extra credit to complete it. The response rate was over 80% for both administrations in both sections.

The survey (see Appendix) assessed students' experiences with the OER lessons and consisted of 18 items; it was adapted from the Student Survey on Experiences with Open eTextbooks used in the OER Adoption Study (California Open Educational Resources Council, 2016). Nine items asked about students' experiences with the OER lessons in terms of characteristics (e.g., engaging, organized, readability, graphics/visuals, met expectations) and two asked them to compare the OER lesson experiences with traditional textbook chapter experiences on a 5-point rating scale (from *strongly agree* to *strongly disagree*, with neutral in the middle). One item asked the students to indicate the methods they used to interact with the OER lessons (i.e., printed, read online, and/or took notes). Two items asked about whether they would recommend the OER lessons to classmates and if they would be interested in using similar OER in future classes; three answer choices (*strongly agree*, *slightly agree*, *no*) were provided to choose from. And one yes/no item asked students whether they were satisfied with the OER lessons. Lastly, three open-ended items ask students to share comments about the aspects of the OER lessons that contributed to their learning, what challenges they faced in using the OER lessons, and ideas for improving their experience with OER resources liked the one they used in the class.

Coding of Student Feedback

Conventional content analysis (Hsieh & Shannon, 2005) was used to qualitatively analyze three open-ended questions: (1) "What aspects of the OER materials contributed to your learning?", (2) "What challenges did you face using the OER materials?", and (3) "What could be done to improve your experience with OER resources like you used in this course?". The steps used to develop the themes reflected within these questions were also guided by Braun and Clarke's (2006) thematic analysis method. Two researchers (both authors of this article) conducted the coding in collaboration in order to achieve triangulation and increased confidence that developed themes were valid (Ryan & Bernard, 2003). The researchers started by reading the responses to each question, highlighting key words and concepts. Then, they began labeling themes that emerged, eventually collapsing these themes into categories. The researchers met to discuss the categories until there was agreement about the number of categories and their definitions. Each researcher then individually coded all student responses using the thematic categories. Cohen's kappa was then calculated for each question: .88 (aspects that contributed to learning), .87 (challenges faced with OER resources), 1.0 (what could improve your experience). These scores indicated satisfactory reliability (Burla et al., 2008). Any discrepancies in agreement between coders were resolved through consensus. The final steps of the analysis involved calculating the percentages and choosing quotes that illustrated each theme. The percentages were calculated based on the total number of responses reflecting each theme, regardless of the semester (spring 2018 or spring 2019) or point in the term (mid-semester, end-of-semester) responses were collected. For question 1, 62 responses were collected (32 at mid, 30 at end); 64 responses were

collected for question 2 (34 at mid, 30 at end); and 60 responses were collected for question 3 (31 at mid, 29 at end).

Results

Performance Results

Independent t-tests results revealed no statistically significant differences in average performance between the textbook and OER groups for any of the three exams or the standardized department final (p 's > .05) (see Table 1).

Table 1. Exam Performance Comparisons by Group.

Assessment	Textbook Group ($n = 48$)		OER Group ($n = 37$)		
	Mean	SD	Mean	SD	
gExam 1	79.6	10.4	77.1	9.6	$t(80) = 1.15, p = .25$
Exam 2	81.1	9.1	81.1	9.6	$t(75) = 0.00, p = .99$
Exam 3	78.1	11.6	77.2	12.7	$t(73) = 0.34, p = .74$
Department Final	79.3	10.6	79.3	9.4	$t(81) = 0.00, p = .99$

Perceptions of OER

Most students rated the OER lessons positively ($\geq 90\%$ agreement) in terms of organization, promotion of learning, and inclusion of helpful examples, visuals, and self-check items (see Figure 1). Two other areas positively rated by the majority (above 80% agreement) were the readability of the OER lessons and their engagement with them. These findings were somewhat similar across both survey periods (mid-semester and end of semester), although the semester ending ratings were generally slightly lower. The slight decrease in ratings of the OER lessons at the end of the semester may be related to the greater focus on more complex research designs and statistics in the latter half of the course.

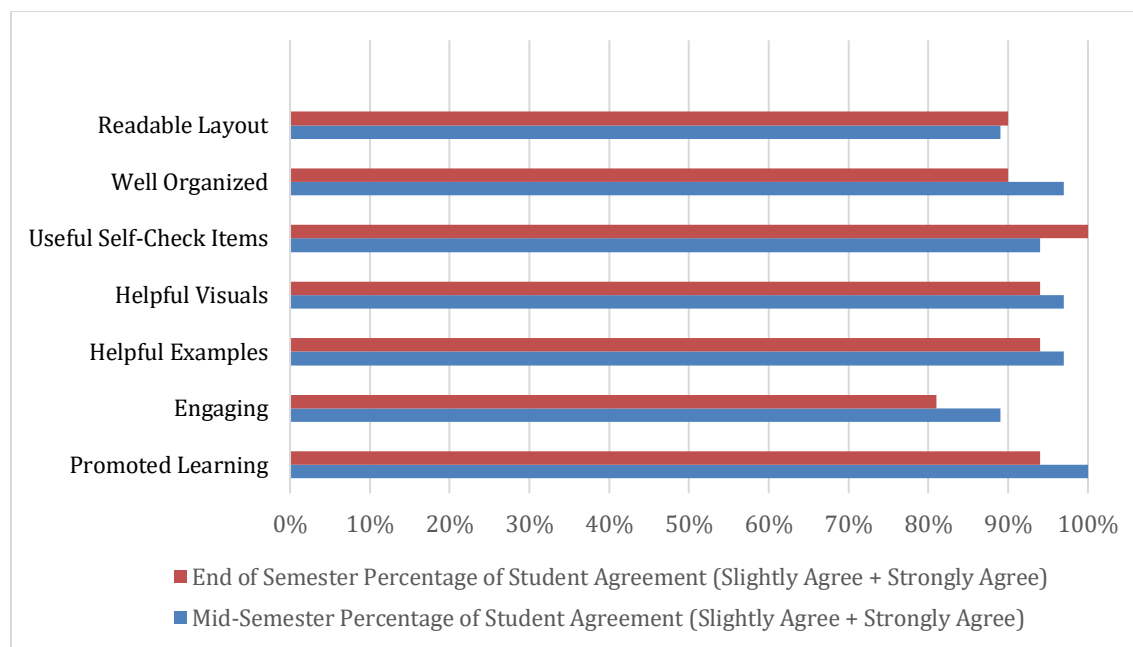


Figure 1. Student Agreement Ratings on Characteristics of the OER lessons.

An overwhelming majority indicated that the OER lessons met their expectations (94% agreement at both mid-semester and end of semester) and were just as thorough in content coverage as traditional commercial textbooks (97% agreement mid-semester; 90% agreement end of semester). Additionally, most students reported a better experience with OER than with traditional commercial textbooks (86% agreement mid-semester; 94% agreement end of semester). Moreover, all students (100%) stated they were satisfied with their experiences with the OER lessons and would be interested in using similar OER in a future course. Regarding use of the OER, most students chose to read the lessons online (94% mid-semester; 90% end of semester), but some also printed the chapters (23% mid-semester; 29% end of semester). Interestingly, the percentage of students taking notes using the OER chapters increased over the course of the semester (71% mid-semester to 81% end of semester).

Qualitative Analysis of Student Feedback

What aspects of the OER materials contributed to your learning? For the first feedback question ($n = 62$ responses total), qualitative analysis uncovered five themes: a) self-check quizzing; b) organization, design, and formatting; c) online accessibility and technical features; d) videos and visuals; and 3) affordability.

The most cited aspect of the OER lessons that contributed to student learning was self-check quizzing (41.9% of student responses). Self-check quizzing referred to the practice quiz items the instructor created and added to the bottom of each page in the OER lesson. Students mentioned the quizzing helping prepare exams and keeping them engaged:

Student: “I am really enjoying my OER lessons because I am able to take my time to read, go over the lessons, and the self-check quizzes make sure that I am engaging in the lesson and learning concept materials.”

Student: “The interactive questions that were provided throughout the lessons were helpful in testing my knowledge of the concepts. Also, it provided another study tool that I could use to prepare for exams.”

The second theme of organization, design, and formatting focused on instructor design elements of the lessons such as layout of pages, chunking and order of topics, and clarity of content. This theme was also common in that 32.3% of student responses mentioned that these features contributed to their learning:

Student: “I love that it gives use the information we need in a language that’s easy to understand...they’re written and organized in such a way that hits each topic and goes in depth without the filler information and fruity language that outdated textbooks use.”

Student: “It broke down the lessons, so it was not overwhelming to read a textbook.”

Student: “Just how well they are organized and cohesively structured. Going page by page and understanding topics as well as being able to easily go back helps a lot.”

The next most common theme involved the online accessibility of lessons and their technical features (e.g., easy to access, navigate, and print), with 9.4% of the responses describing that these elements contributed to their learning:

Student: “I was able to easily navigate through them to read and study for before exams. The OER were always accessible through my phone if I did not have my laptop and didn’t have to carry around another book.

Student: “Being able to save the lesson as a PDF after completed. It really helps when I am studying, I can type in the search bar for exactly what I’m looking for.”

Student: “I liked being able to print out the pages so I could be highlight and make notes of things. I usually rent book so being able to print and write on things was big for me. They were easy to access before tests as a review as well which was helpful.”

Some responses (9.4%) also mentioned that they found the videos and visuals helpful for their learning (e.g., photos, figures, and graphs):

Student: “The videos and graphics were a great learning tool for me as it made my understanding of the material flow together.”

Student: “I am more of a visual learner, so the visual aids helped with the learning mechanism.”

Interestingly, only a few students (1.6%) specifically mentioned affordability as a positive for their learning in the course, as described by this student:

Student: “For a lot of college students, we are renting our textbooks due to costs. However, this has cost me nothing AND I’m able to print out pages I need extra help with. I often print and highlight everything, and it helps me study better for exams. I’ve found the OER materials more helpful than the other three textbooks I had to rent this semester.”

What challenges did you face using the OER materials? For the second feedback question ($n = 64$ responses total), four themes were present: a) online challenges; b) design and format challenges; c) technology challenges; and d) personal challenges.

Online challenges included difficulties reading the screen and distractions such as being tempted to navigate away from the text and look at other pages on the internet. These were reported by 17.2% of student responses:

Student: "Staring at the screen too long hurts my eyes."

Student: "Since the OER chapters are online, it is very easy to get distracted/procrastinate."

Student: "Trying to stay off Facebook and Amazon, LOL."

Design and format challenges were evident in 15.6% of student responses. These included concerns that the modules/chapters were too long or that there were not enough visuals or relevant examples:

Student: "There was quite a bit of material to read so it was difficult to stay engaged."

Student: "Challenges that are faced are the relatability of the examples that are provided; some examples are complex."

Student: "Staying focused with the lack of visuals."

Another set of common challenges (14.1%) included technology issues such as problems with the videos freezing, difficulties printing materials, or being unable to adequately read the lessons on their mobile devices:

Student: "At first downloading one of the modules was difficult because it was considered a popup on my laptop."

Student: "The way the lessons print out could be worked on. So, they don't cut off graphs or print blank spaces."

Student: "Sometimes it was hard to access through mobile devices."

Some student comments also mentioned personal challenges (6.3%), which included procrastination or critiquing their own study strategies with OER lessons:

Student: "Putting the OER towards the last minute and focusing on answering the questions rather than focusing on the bigger picture."

Student: "I didn't take notes and I should have, or I really should have printed the notes."

It is important to note that 51.6% of the responses reflected that students experienced no significant challenges with the OER materials.

What could be done to improve your experience with OER resources like you used in this course? A total of 60 responses to this question were recorded across semesters. Most of the student responses (61.7%) stated they did not have any further suggestions for improvement of the OER resources. However, for those who provided recommendations, three themes were found: 1) design and format changes, 2) technology enhancements, and 3) personal strategies.

The most common recommendation for improvement (21.7% of responses) involved proposed changes for the design, organization, and/or content of materials. More specifically, some wanted less content or had suggestions for added features such as study guides, videos, or better examples:

Student: “I think it would be helpful to format questions on the OER lessons like they would appear on the exam to help ease the exam nerves.”

Student: “I would say to include more videos explaining the topics since some were difficult to understand.”

Student: “What would have been helpful was to incorporate examples that ties in with the material being taught that was interesting or relatable. Along with this, the formatting of the text was intimidating at times as the paragraphs were lengthy.”

Other recommendations for improvement included technology enhancements (8.3% of the comments), such as better printing options and additional features permitting note taking, text highlighting, and audio components:

Student: “Allow there to be a notes section to the side where we can highlight/write on the text or enter text bubbles where we can write down examples or reminders for when we entered the module.”

Student: “Have an audio version of the text.”

Student: “Make the lessons more printer friendly.”

Some comments (8.3%) also mentioned personal strategies students would recommend or use next time to improve their experiences with the OER, such as printing out lessons, taking notes, and procrastinating less:

Student: “Take notes while reading over the material.”

Student: “I think the OER lessons are pretty thorough and complete I just need to put more of my part and not read through the lessons in such a hurry.”

Discussion

This study sought to investigate the effectiveness of a course redesign using interactive OER lessons in place of a commercial textbook. Quantitative analyses revealed that there were no significant differences in scores for any of the three exams or the department final when comparing students in the OER sections to those in the previous textbook sections. These results are consistent with meta-analyses indicating that student performance and learning is similar whether using OER or commercial

textbooks (Clinton & Khan, 2019; Hilton, 2020). Although many past studies are limited by the lack of control of teacher variables, this study minimized possible differences due to teacher effects because all sections were taught by the same person. Furthermore, measures of student learning in this study were consistent across the OER and non-OER sections. These included midterm exams that were the same for all sections and a department-required final that is purposefully developed to be of uniform difficulty each semester. These results support previous findings that student learning is not negatively impacted by using OER materials and that instructors can be confident that such materials can effectively cover course content in a manner on par with traditional textbooks.

In addition to student performance, this study also examined results from a survey of student perceptions regarding their experiences with the OER lessons. To provide context to the satisfaction ratings, over 90% of the students reported reading the lessons online, while only about a quarter of students also printed chapters. Most students took notes while reading the lesson, and this increased from 71% in the mid-semester to 80% at the end of the semester. Students' ratings of the OER lessons were overwhelmingly positive, with the highest agreement for items assessing the extent to which the lessons' organization, examples, visuals, and self-check questions helped them to understand concepts. They also agreed that the format of lessons was readable and engaging. Although end of the semester ratings were slightly lower than those at mid-semester, differences in the complexity of topics later in the semester could account for this minor decrease. The difficulty of content in the second half of the semester may also explain why more students took notes at this time. Impressively, all students reported that they were satisfied with their OER experience and would be interested in using OER in future courses. When asked to compare OER to traditional textbooks, nearly all agreed that the content coverage was just as thorough and most felt that they had a better experience with OER. Unfortunately, student perceptions of the commercial textbook were not collected; thus, it's difficult to know how students would compare the two course materials side by side without the same survey questions being asked for both groups.

The qualitative student feedback provided context to the students' high satisfaction ratings of the OER lessons by documenting the aspects that added to their learning. Overwhelmingly, students praised the self-check quizzing, noting its helpfulness for assessing their understanding of the course material as they were reading, in addition to serving as a study tool to prepare for exams. Other elements that served students well were related to the design, organization, and online accessibility of the OER lessons. Chunking material by themes, adding appropriate images and videos to reinforce major course concepts, and ensuring their alignment with the module's content focus worked effectively for student learning. Creating the lessons with Softchalk software also permitted easy navigation with clickable page links and a table of contents, and the option to print or save any of the lessons as a resource for future use. All these benefits noted by students are consistent with the power of customizability that OER affords an instructor: the opportunity to increase the relevance and interactivity of course materials for better student engagement (Griffiths et al., 2020; Van Allen & Katz, 2020). Because the instructor was able to remix and adapt the OER lessons to best fit the order and depth of the course's weekly module topics, the students viewed the OER lessons as personalized to their learning, with ample opportunity to practice and re-practice course material as they deemed needed. Hodgkinson-Williams and Trotter (2018) suggest that instructor remixing and adaption of OER can also lessen cultural inequalities by deliberately transforming multiple materials into a "coherent educational resource appropriate for a local context" (p. 217).

Although slightly more than half of the student responses indicated no challenges with using the OER lessons, a few areas of concern are recognized. The online nature of OER and e-textbooks may pose a problem for some students in that reading online may put additional strain on the eyes and lead some students to be distracted by the ease of internet surfing. Technology problems, such as access to internet and its speed, along with the type of device used, may also limit some students'

ability to effectively interact with components of OER lessons such as built-in videos, quizzing, etc. Some students also expressed personal concerns related to procrastination and the desire to have used alternative study strategies. Two recommendations, consistent with Darby's (2019) suggestions for effective, inclusive teaching online, are proposed to lessen these challenges: (1) Survey students at the beginning of the semester to assess their access to the internet and the devices they have available to connect to the internet to ensure they can effectively use the interactive components (Note: the instructor did survey all students at the start of the semester about their internet access and availability of a reliable device for completing the OER lessons, and any students needing equipment, such as a hot spot or laptop, were provided one through a loaner program by the campus IT department); and (2) Early in the semester, share best practices for studying and preparing for exams using OER content to provide all students with a foundation for success.

Another common challenge mentioned in students' responses and consistent with the most common improvement suggestions for the OER lessons revolved around design and format changes. A few of the formatting elements were directly tied to limitations of the software chosen to create the OER lessons: printing issues, mobile friendliness, and additional highlighting, notetaking, and audio features. An advantage of today's technology is that newer versions of software become available relatively quickly, thus Softchalk, the program used to create the OER lessons, in its newest edition has improved its usability on mobile devices and its accessibility with screen readers and keyboard navigation, eliminating some of the challenges previously noted by students. It is also not necessary to use any specific software when customizing OER; there are free tools available where this can be done at no cost to faculty or students, in addition to the Learning Management System used by most institutions. Although a lot of instructor effort went into chunking the OER into digestible pages within each lesson that were accompanied by relevant examples and videos, students still felt these areas could be improved. Specifically, students noted the desire for more relatable and interesting examples and shortened paragraph lengths. These improvement suggestions reinforce the personalization benefits of OER as the instructor will be able to continue to make iterative enhancements to the format and design of the lessons over time based on student feedback (which is far more limited and difficult with commercial textbooks due to copyright restrictions). Moreover, getting students involved in OER creation and/or the remixing process could enhance the OER relevancy. Veletsianos (2020) argues that diverse voices should be integrated into OER curricular materials in meaningful and substantive ways if we are to expand equity and achieve inclusion. Thus, it is recommended that instructors build in opportunities for students to provide suggested changes and additions to OER that incorporate their varied perspectives and experiences.

Limitations and Future Research

Findings from this study must be interpreted within the context of the small sample size and largely female sample, which limits generalizability. Additionally, the non-experimental nature of the case study does not permit causal conclusions to be made. For example, since students were not randomly assigned to conditions, differences in student characteristics or changes in the university setting over time were not controlled. Furthermore, student academic performance was measured with exam scores; overall grade comparisons could not be made because assignments were not held constant across the sections. Future research should attempt to incorporate randomization and standardized measures for more definitive group comparisons and conclusions (Hilton, 2020). Larger student representation in such studies would also permit disaggregate data for analyzing OER benefits among varying student demographics.

Additionally, it is recommended that future research expand beyond the context of the direct benefits of OER use for students and investigate the potential indirect benefits of OER, such as

changes to instructor teaching practices. Because of the academic freedom that OER open licensing affords faculty, it is important to study whether instructors make transformative pedagogical changes as a result of customizing OER. Moreover, future research should examine the potential advantages of student participation in the OER customizing process and how that may impact both learning outcomes and feelings of inclusion.

Appendix

Appendix 1. Student OER Survey.

Experience with OER Lessons.

OER stands for open educational resources. In this course, you used OER lessons (“chapters”) instead of the traditional textbook chapters. Please help me in evaluating your experience with the OER alternative (“interactive lessons”) used in this class.

The OER lessons helped me to understand key concepts from the course.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

The OER lessons were engaging to me.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

I had trouble accessing the OER lessons for this class.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

The OER lessons were organized in a way that helped my understanding of course concepts.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

The OER lessons had a layout that contributed to the readability of the materials.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

The OER lessons used graphics/visuals that helped my understanding of course concepts.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

The OER lessons used examples that helped my understanding of course concepts.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

The OER lessons used self-check items that helped my understanding of course concepts.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

The OER lessons used in this course met my expectations for the class.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

Which method(s) did you use with your OER chapters (interactive lessons)? (check all that apply)

Printed the lessons, Read it online, Took notes

I would recommend the use of the OER lessons/chapters to my classmates.

Strongly agree, Slightly agree, No

Based upon my experiences in this class, I would be interested in using an OER textbook/lessons in a future course.

Strongly agree, Slightly agree, No

Overall, were you satisfied with your experiences with these OER lessons/chapters?

Yes, No

OER Comparison to Textbooks

Please compare the OER “interactive lessons” used in this class to your experience with regular textbook chapters used in other courses.

The OER textbook lessons/chapters were better than my experience with regular class textbooks.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

Overall, compared to regular textbooks, the OER lessons/chapters were just as thorough and complete in covering required topics and competencies.

Strongly agree, Slightly agree, Neutral, Slightly disagree, Strongly disagree

Comments

Please share your comments about using the open e-textbook chapters/lessons in this course. Your feedback is important. However, if you don't have any feedback for that item, feel free to write N/A.

What aspects of the OER materials contributed to your learning?

What challenges did you face in using these OER chapter lessons?

What can be done to improve your experience with resources like the one you used in this course?

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