



OER at Scale: The Academic and Economic Outcomes of Achieving the Dream's OER Degree Initiative

Winter 2020

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Suggested Citation

Griffiths, R., Mislevy, J., Wang, S., Ball, A., Shear, L., Desrochers, D. (2020). *OER at Scale: The Academic and Economic Outcomes of Achieving the Dream's OER Degree Initiative*. Menlo Park, CA: SRI International.

Acknowledgments

This research was made possible by the collaboration and support of many individuals beyond the SRI Education research team. First, we appreciate the willingness of participating college administrators, faculty, staff and students to cooperate in the research. Their commitment to learning from the initiative and helping inform the work of other educators interested in scaling up OER was inspiring. We are especially grateful to the research and cost partner colleges, who provided complex and not always easily accessible data, including: Alamo Colleges, Austin Community College, Borough of Manhattan Community College, Bunker Hill Community College, Central Virginia Community College, Forsyth Tech Community College, Herkimer College, Monroe Community College, Montgomery College, Pierce College, and Santa Ana College. We also appreciate the support of the Bill & Melinda Gates Foundation and the Ascendium Education Group for their support of this work. Finally, we wish to acknowledge the support and valuable collaboration with staff at Achieving the Dream throughout this study.



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Letter from Achieving the Dream President and CEO, Dr. Karen A. Stout



Achieving the Dream is pleased to share the third, and final, report on our Open Educational Resources (OER) Degree Initiative, the result of a comprehensive research and evaluation study conducted by our partners at SRI Education and rpk GROUP. The OER Degree Initiative, which we launched over three years ago, was an ambitious project involving a total of 38 community colleges across 13 states, four grant partners, and five funding organizations. The scope of the initiative, made possible by a generous investment from our funders--The William & Flora Hewlett Foundation, the Bill & Melinda Gates Foundation, Ascendium, and the Speedwell and Shelter Hill Foundations—was not only an opportunity to significantly scale OER but also try to answer important questions about the academic and economic impacts of broad institutional adoption of openly licensed materials.

In 2016, the OER degree model was relatively new. Most OER efforts were undertaken by individual faculty on individual courses and not meaningfully connected to the broader goals of the institution. Converting entire degree programs to OER requires colleges to intentionally integrate this OER degree work into their institutional processes and organizational strategies: connection and scale are built-in from the start, ingredients ATD has learned must be part of any reform designed to move the completion needle.

Today, as a result of this and other efforts, the national OER landscape has changed. There have been significant state and federal investments in OER programs, and interest in broad OER implementation from state legislatures and college systems across the U.S. continues to grow. There is also increasing recognition of how OER adoption can drive innovation in curriculum and pedagogy. At Achieving the Dream, OER work

is an important component of our work helping foster cultures of teaching and learning excellence at all of our colleges

I invite you to spend time with the full report, which expands on the findings of two [earlier reports](#) from the OER Degree Initiative. However, I do want to highlight a few of the findings. First, the results of the cost study—both in estimating overall student savings as well as overall program costs—are groundbreaking and immensely useful for college leaders weighing an institutional investment in an OER degree. Also of note: the academic outcomes on progress to degree are significant and exciting, showing that students enrolled in multiple OER courses attain more credits than their non-OER counterparts. We know that the more credits community college students earn, the likelier they are to complete. Finally, this work required deep engagement from faculty, who were critical to the initiative's success. It is telling, then, that over the course of the study, participation in the initiative grew to

nearly 2,000 faculty. This clearly shows the power of OER as a lever for faculty engagement and is an encouraging sign that these programs will continue to grow.

Achieving the Dream is grateful for the support of funding and research partners, as well as the 38 institutions that participated in this effort. We are committed to growing our work with ATD Network colleges to design truly student-centered institutions and will continue to advance success for all students through innovation and by sharing what we are learning with you.

Sincerely,

Dr. Karen A. Stout



President & CEO
Achieving the Dream, Inc.

Executive Summary

Achieving the Dream's Open Education Resource (OER) Degree Initiative enabled 38 colleges nationwide to offer 6,600 OER course sections over two and a half years, reaching nearly 160,000 students. Approximately 2,000 instructors participated in the development and delivery of these courses, substantially expanding the number of faculty with OER experience at participating colleges. Nearly 600 courses were redesigned and certified as OER, contributing to the availability of OER content. **The initiative saved students at least \$10.7 million in instructional material costs.**



The research and evaluation of ATD's OER Degree Initiative provided encouraging evidence regarding the academic outcomes of students who enrolled in multiple OER courses, the economic impacts for both students and institutions, and the experiences of key stakeholders. Students benefitted from unrestricted access to course content and improved course experiences, in addition to saving money that could be used towards other educational or personal expenses. Most students found OER materials accessible and well aligned to learning objectives. Evidence from 11 “research partner” colleges suggests that **students who took multiple OER courses on average earned more college credits over time than otherwise similar students who took no OER courses.** Overall, this benefit did not vary significantly for underserved

students versus other students. Students who took OER courses had similar cumulative GPAs as other students, on average.

Instructors engaged in the OER degree primarily to reduce financial burden on students and to ensure they had access to course materials.

Most instructors reported that OER at least somewhat changed the way they presented and used materials in class, increased the relevance of those materials, and influenced their pedagogical beliefs overall. They were less confident, though, that these enhancements would lead to differences in student outcomes.

Launching OER degrees demanded institutional efforts. Instructors bore the brunt of the workload for converting the 20+ required courses to OER, which took much more time than developing

traditional courses. This work was not done in isolation, however, as academic departments collaborated to identify courses required for degrees, recruit faculty, and redesign courses; service units provided training and course development supports; and administrative staff worked to make students aware of OER options, mobilize resources, and clear obstacles.

Colleges invested a substantial amount of their own resources both directly and indirectly through staff and instructor time to develop OER programs, which cost an average of \$576,000 at five partner institutions that contributed detailed cost data (“cost partners”). **Some of these colleges were expected to recoup their investments or generate a positive return** as students who took OER courses attempted more credits, boosting tuition and fee revenue. The average cost of providing OER degree courses (\$70 per student) declined rapidly as enrollment in redesigned OER courses increased. Student savings averaged \$65 or more per course after factoring in purchasing patterns.

Overall, the OER Degree Initiative offers an important demonstration of the opportunity, the task, and the challenges of a systemic approach to OER.

Background

ATD’s OER Degree Initiative aimed to increase college affordability and student success by catalyzing an institutional commitment to OER.

This initiative was motivated by the expectation that an “OER degree,” or pathway of OER courses that together meet the requirements for a degree

program, could set an ambitious goal for scaling up OER course offerings. Converting courses to OER could reinvigorate curriculum and pedagogy, leading to improved quality of instruction. At the same time, redesigning courses with OER is often time-consuming and demands new skills and supports for instructors. Scaling within institutions thus entailed an organizational effort that bridged departments and units, potentially enhancing institutional culture.

Program sponsors also hypothesized that **students could benefit from cumulative exposure to OER courses more than from one-off OER course taking**. These broader potential effects of OER course taking could be significant given that cost savings may influence students’ academic trajectories and progress toward degrees, for example by enabling students to enroll in more courses or work fewer hours outside of school. These benefits may be particularly important for students from low-income families and underrepresented minorities, who are disproportionately enrolled in community colleges.¹ Investigating the effects of taking multiple OER courses on students’ progress to degree was thus a high priority for the initiative.

Finally, scaling OER course development across a substantial number of institutions was expected to increase the supply of vetted OER course content. Progress in content development would in turn address one of the major challenges to OER conversion – the availability of high quality OER content – and thus lower barriers to adoption beyond the participating colleges.

¹ Deane, K. C., Fink, J., Gordon, M., Jenkins, D., Kadlec, A., & Wyner, J. (2017, December). *Tackling Transfer: A Guide to Convening Community Colleges and Universities to Improve Transfer Student Outcomes*. Retrieved from <https://ccrc.tc.columbia.edu/publications/tackling-transfer-guide-convening-community-colleges-universities-improve-transfer-student-outcomes.html>

Achieving the Dream (ATD) is committed to strengthening community colleges' capacity to enable students' economic and social mobility through sustainable institutional improvement. Recognizing the potential for the OER degree model to complement its emphasis on institutional transformation, ATD launched the OER Degree Initiative with 38 colleges across the U.S. The initiative enabled participating colleges, which include four state consortia, to develop pathways of courses using entirely OER. The initiative was supported by The William and Flora Hewlett Foundation, the Bill & Melinda Gates Foundation, the Ascendium Education Group (formerly the Great Lakes Higher Education Guaranty Corporation), the Shelter Hill Foundation, and the Speedwell Foundation. In addition, ATD partnered with Lumen Learning to provide technical assistance and to ensure that OER courses developed through the program adhered to open licensing requirements, and with the Community College Consortium for Open Educational Resources (CCC-OER) to provide a community of practice. SRI Education, together with rpk GROUP, was selected to lead the research and evaluation for the initiative.

From summer 2016 through fall 2018, SRI conducted extensive data collection activities including:

- Collecting data from participating colleges on the number of OER courses offered through the program, the number of instructors involved, and the number of students who enrolled in and passed OER courses.
- Conducting an instructor survey in fall 2016 and again in fall 2018 in order to examine instructors' backgrounds, their experiences using OER, the kinds of institutional supports they received, and their perspectives on the program. In total 300 instructors participated in the 2016 survey (a 67% response rate) and 906 instructors participated in the 2018 survey (a 65% response rate).
- Conducting a survey of students enrolled in OER courses at 12 colleges in fall 2017 in order to investigate students' perspectives

and experiences in OER courses. We received responses from 2,440 students—a 41% response rate.

- Visiting 10 colleges in fall 2017 through spring 2018 in order to gain deeper insight into student and instructor experiences and implementation facilitators and barriers.
- Collecting student-level data from 11 "research partner" colleges to conduct impact analyses on progress to degree.

rpk GROUP, a partner in this research, also conducted data collection activities around the economic impacts of OER, including:

- Collecting data from all grantees on students' academic costs; OER and total enrollments, courses, course sections, and student credit hours; bookstore sales information; and incidental OER fees and course material costs.

- Collecting additional data from five “cost partner” colleges on program revenues and expenses, including instructor time logs that captured their OER course development activity.
- Accompanying SRI on visits to the five cost partner colleges in fall 2017 through spring 2018 to gain insight on students’ perspectives on costs, instructors’ course development experiences, and college and bookstore administrators’ perspectives on the economic impacts of OER.

Major Findings

Scaling OER Course Offerings

Data provided by participating colleges indicated that the OER Degree Initiative succeeded in scaling provision of OER courses.

Over the course of the program, nearly 2,000 instructors offered over 6,600 OER course sections, reaching nearly 160,000 students. Of those, almost 65,000 were Pell eligible, and 115,000 students completed these OER courses with a C- or better, for an overall pass rate of 70%.² From summer/fall 2016 to summer/fall 2018, within participating colleges:

- The average number of instructors teaching OER courses through the program rose from 10 to 42.
- The average number of OER sections offered grew from 22 to 101.
- The average number of students enrolled in those sections rose from 564 to 2,425.

Developing OER degrees involved substantial collaboration across academic departments and service units. The share of instructors reporting

that they had worked with colleagues on developing OER courses rose from 49% to 58% over the course of the initiative, and the share reporting that they had reviewed a course taught by a colleague, had their own course reviewed, or co-taught a course also increased. At the same time, the share of instructors who received training decreased, as 56% of instructors reported receiving training in OER use -- down from 70% in 2016. As OER course conversions were completed, adjunct faculty who were not involved in course development taught a larger share of courses.

The OER Degree Initiative generated 586 OER courses that were certified by Lumen Learning as meeting open license requirements, a requirement for the ATD initiative. These covered a broad range of disciplines and course levels. Twelve percent of instructors reported that their OER courses primarily consisted of newly created content, while 33% integrated existing OER from multiple sources.

Student and Instructor Perspectives

A survey of over 2,400 students supported the premise that traditional textbooks pose a financial barrier for students. Fifty-three percent said they had not purchased required materials for a course at least once, and the most common reason was cost. Forty-one percent said OER courses would have a significant positive impact on their ability to afford college. The share of students reporting financial strain due to textbook costs was higher for Pell students and underrepresented minorities. On the other hand, relatively few students reported that they had withdrawn from a class or stopped taking

² Some schools only had Pell award status (as opposed to eligibility), or we had to impute based on the overall institution average, thus these numbers are estimates.

courses for a semester or more due to costs (12% and 16%, respectively).

Students in both the survey and focus groups mostly reported positive experiences in OER courses. They appreciated that the materials were closely aligned to what the instructors wanted them to learn and were well organized and easy to navigate. Some commented that the course content was more up-to-date and relevant. **Many students emphasized the fact that they could access course materials online.** Only a small share of students reported having problems accessing OER, and 13% purchased printed copies of the materials. **Most students were not aware that their courses were OER when they enrolled and had not heard about OER degrees,** suggesting that the program was not always visible to students who could potentially have benefitted the most.

Surveys in 2016 and 2018 of over 1,000 instructors revealed increasing influence of OER use on pedagogical principles and adaptation of OER materials used in courses. Instructors were more likely to report that OER influenced the relevance and use of instructional materials in their courses than their pedagogical strategies. Instructors were cautious in their assessments about the extent to which use of OER increased student engagement, preparation, and achievement in their courses.

Instructors' perceptions of OER were mostly positive and improved over the course of the initiative, although perceived barriers to use of OER also increased. Those who received training and who were satisfied with the training they received generally had more positive perceptions. Forty-three percent of instructors thought their OER programs would "definitely" be sustained, and another 48%

thought these programs may be sustained. Eighty-three percent said they would not return to using traditional materials in their courses.

Academic Impacts

A primary goal of the study was to determine, with as much confidence possible, whether the availability of OER degree options enabled students to progress more quickly towards attaining degrees and whether effects varied for different types of students. SRI worked with 11 colleges ("research partners") to conduct quasi-experimental impact studies examining whether OER course enrollment was associated with differences in credit accumulation and cumulative GPA over multiple terms.

One challenge we encountered was that **colleges generally did not offer OER courses to students as explicit pathways, thus most students enrolled in a mix of OER and non-OER courses.** Most students took fewer than four OER courses, our original definition of having received the "treatment." We therefore modified our study design to designate two levels of treatment depending on the distribution of course taking at each college: students received "high dosage" if they took three or more OER courses and "low dosage" if they enrolled in one or two OER courses. We then compared indicators of progress to degree (credit accumulation and cumulative GPA) for treatment students with those of otherwise similar students who took no OER courses using matching techniques and controlling for background characteristics. We also investigated whether effects of OER course taking varied by demographic group.

In 6 of the 11 colleges, treatment students taking a mix of high and low dosage of OER courses earned significantly more course credits than those who had not taken any OER courses. The number of additional credits earned by treatment students ranged from 2 to 8 across these six schools. In the remaining five colleges, students' credit accumulation in the two conditions was not statistically different after controlling for differences in student characteristics and, in some cases, the number of semesters in which they enrolled. We also calculated effect sizes for each college and found that **3 of the 11 colleges had findings that equate to treatment students taking at least one more course (3 credit hours) on average than the comparison students.**

An examination of the circumstances under which OER degrees were more or less effective did not reveal significant variation by institution size, share of adjunct instructors, availability of training, and overall instructor satisfaction with their experience adopting OER. Nor was the size of the effect associated with particular study design features. The lack of significant moderating effects may be because our 11-college sample was not large enough to identify modest underlying influences.

While OER course taking was associated with higher credit accumulation in most colleges, results for cumulative GPA were more mixed.

Out of nine colleges that provided sufficient data to calculate students' cumulative GPA, treatment students taking OER courses achieved a significantly higher GPA than otherwise similar students at just one college, and approached statistical significance in another, while results were negative and statistically significant in two others. In the remaining five colleges, students' cumulative GPA was not

statistically different after controlling for differences in student characteristics. **These findings indicate that students were able to maintain GPAs despite taking more courses, on average.**

We also examined the effects of OER course taking for different types of students. In 3 of the 6 sites with statistically significant impact on credit accumulation overall, this difference also appears to be associated with Pell status. For two of the colleges, Pell students appear to have benefitted even more; in the other site, the gain in credit accumulation for Pell students was less than that for non-Pell students. Racial/ethnic identity was generally not associated with whether OER course enrollment affected cumulative GPA. **Our observation of few significant interaction effects means that OER degree programs generally benefitted different groups of students to a similar degree, and in a couple cases, Pell students may have benefitted even more.**

Finally, SRI conducted several analyses to better understand the potential influence of retention on credit accumulation. In 8 out of 11 of the impact analyses, the number of semesters in which students enrolled was significantly associated with credit accumulation and cumulative GPA. As such, we opted for a conservative approach of controlling for the number of semesters in which students were enrolled in the academic impact analyses.

This approach reduces the risk that students received the treatment as a result of longer retention (giving them the opportunity to take more OER courses), but conversely raises a risk that the benefits of OER course taking are underestimated, given that OER use is theorized to positively effect retention.

Ultimately, **the positive associations between OER course taking and credit accumulation observed in this study are encouraging and suggest that this approach merits further application and study.** At the same time, given limitations of the study design, we cannot say with confidence whether the observed benefits are caused by OER course taking or some other factor such as student motivation.

Economic Impacts

Cost analyses by rpk GROUP also produce encouraging results regarding economic impacts on students and institutions. These analyses are based on data provided by all participating colleges and on detailed cost and activity data provided by five “cost partner” colleges. The initiative **resulted in student savings averaging \$65 or more per student per OER course by eliminating the need to purchase commercial textbooks and other course materials.** These estimates take into consideration typical student purchasing patterns and incidental OER costs associated with some OER courses. The overall net savings to students from the ATD OER Degree Initiative is estimated at \$10.7 million or more during the two-and-a-half-year grant period.

For institutions, OER course development was the primary cost driver. OER courses took about 180 hours on average to develop. **The compensation cost (salary and benefits) of developing OER courses averaged \$12,600 at the five cost partner colleges during the grant period,** far exceeding faculty stipends that they received for their participation in the program. We found little variation in development costs for adopting vs. adapting existing OER materials, while STEM courses and those using open interactive

learning systems (such as MyOpenMath and Lumen’s Waymaker) incurred substantially higher costs. Team-based course development efforts initially cost more, but ultimately incurred lower per student unit costs due to more expansive adoption. **The most cost-efficient courses were non-STEM courses created by adapting existing OER materials or adopting open textbooks.**

The full cost of developing an OER degree pathway averaged \$576,000 across the five cost partners during the 2.5-year grant period.

Program costs varied among the cost partners, ranging from approximately \$300,000 to \$1 million. Two-thirds of all cost partner expenditures supported the development of OER courses, while the remaining one third went towards general program support. College resources funded most of the OER degree pathway development costs. While more than one-half of budgeted funding came from foundation grants from the ATD initiative or other OER-related projects, more than half the total resources expended for the program were provided indirectly, mostly in the form of faculty and staff time. The impact on college bookstore revenue was modest.

Colleges have opportunities to reduce their ongoing costs while also expanding OER opportunities by introducing new efficiencies and shifting focus to unit costs (i.e., the cost per student enrolled in OER courses). **The colleges’ cost of developing an OER pathway averaged \$70 per OER enrollment, but by the final six months of the grant initiative, unit costs declined to \$21 as spending on new course development declined and average OER enrollments grew.**

Our analysis suggests that investments in OER degrees at 3 of the 5 cost partner colleges were

recouped, and changes in credits attempted generated positive net revenue for two of those institutions. For these two colleges, the estimated additional revenue from credit hours attempted exceeded the colleges' investments in their OER programs and the additional instructional costs associated with increased course taking. **When the impacts across all five cost partner colleges are taken into account, estimates suggest an average of \$1.03 in gross revenue was generated for every dollar spent (program and additional delivery costs)—a modest 3% institutional return on investment that reflects an average net financial benefit of \$38,000.** In other words, the students' savings generated by OER degrees did not come at a cost to the colleges. The financial return on investment varied widely across colleges depending on program costs and the additional student credit hours attempted.

It is important to emphasize the methodological limitations of our impact analyses and, relatedly, our estimates of the return on investment for OER degrees at partner institutions. It was not possible to account for potential benefits of increased retention given our study design and observed patterns of course taking, thus both academic gains for students and the return on investment for colleges may be underestimated. **While OER course taking was associated with higher credit accumulation in the majority of research partner colleges, we cannot be confident that OER course taking caused this outcome.** Further research is needed to determine whether students taking multiple OER courses earned more credits because cost savings enabled them to enroll in more courses, because the quality of courses was higher, or for some other reason. A closer examination of instructor practices

and pass rates in OER sections compared to traditional versions of the same course may shed light on these questions.

Summary and Implications for Future Directions

OER adoption is a strategic institutional initiative. Units across campus must work in coordination to plan and execute the development of OER courses across departments as well as related policies and practices for service units, advising, bookstores, and administrative functions. In some cases, participating colleges had a strong foundation of OER activity on which to build, while others started with a limited base of experience with OER. We observed several ways in which OER programs unfolded: at some colleges OER use originated with grassroots faculty adoption, while at others programs were launched via administrative initiatives or grant programs. In a few cases, libraries or centers for teaching and learning had initiated OER programs by providing faculty learning opportunities and support services. Both grassroots faculty engagement and senior administrative support appear important to program success.

Through site visits and instructor surveys, we identified several opportunities for colleges to expand the impact of OER degrees:

- **Connect OER degrees with strategic goals and provide high level administrative support.** Senior administrative support was important to build momentum, recruit faculty, and clear obstacles. In most cases administrators were able to articulate connections between the OER Degree Initiative and broader strategic

goals, such as equity, access, and affordability. In practice, however, these connections were sometimes enacted at a superficial level. Project leaders can take additional steps to operationalize connections between OER programs and other strategic initiatives such as guided pathways and advising reforms.

- **Ensure faculty receive learning**

opportunities and supports. Given the up-front time required to develop OER courses and the many demands on instructors' time, it is likely unrealistic to expect this model to scale up through individual volunteer efforts. Provision of OER training and course development supports can enhance the instructor experience and potentially improve course quality. Opportunities for collaboration with colleagues can also build morale.

- **Address logistical and cultural barriers to course sharing.** The OER Degree Initiative aimed to increase the supply of high-quality OER courses and thus reduce obstacles to scaling adoption. Future initiatives might explore further what infrastructure and incentives can facilitate course sharing, especially across colleges.

- **Communicate OER options strategically to students.** Data collections in fall 2017 and spring 2018 revealed low student awareness of OER course options and degrees. Many colleges were relying on communication channels that proved ineffective at reaching students for this purpose, such as the college website. Given the common strategic objectives of OER initiatives to advance equity, affordability and access goals, colleges should develop strategies to target communications about OER options to students they most wish to reach.

- **Encourage practices to pursue efficiencies.**

Identifying OER materials, academic supports, and best practices that reduce faculty time spent finding and revising OER materials can reduce OER course development costs. Practices and policies that encourage efficient use of time and resources and that scale section offerings and enrollment in OER courses over time will also reduce the cost per OER student. Team course development can yield such efficiencies.

The concept of an OER degree pathway was useful in setting a point on the horizon around which to galvanize cross-institutional activity.

The premise of enabling students to obtain a degree without paying a single dollar for instructional materials is compelling and easy to understand and communicate. So too is the argument that cumulative exposure to courses redesigned with OER is more likely to change students' academic trajectories than simply taking one-off OER courses. Finally, elevating OER into a pathway raises the likelihood of a coherent student experience supported by a coordinated and sustainable set of activities.

We observed signs that part of this vision – the benefits of implementing OER at scale within an institution – were realized. The number of OER sections available to students and the population of instructors involved in OER and having positive experiences expanded dramatically. By the end of the initiative critical pieces, such as adding OER tags to course catalogues, were falling into place at many colleges. Instructors were mostly optimistic that OER degree programs would be sustained on their campuses, and 83% indicated that for courses they had already taught as OER, they would not return to traditional materials.

On the other hand, we did not see evidence that most colleges truly implemented degree “pathways.” The majority of students who were affected by the initiative took fewer than four OER courses over multiple terms. Few campuses put policies in place to facilitate enrollment in a sequence of courses in the targeted major, for example by scheduling courses in blocks. It is possible that two and a half years was not enough time to convert the courses needed for a degree and to put all the other structures in place to support a degree pathway. On the other hand, instructors unexpectedly reported increased barriers to OER course development in 2018 relative to 2016, suggesting that availability of supports and resources may have waned as the grant period drew to a close and raising questions about the sustainability of those supports in the absence of ongoing external funding.

In sum, it appears likely that many colleges will continue their OER programs, but not necessarily with a focus on OER degree pathways. For example, some may prioritize conversion of large enrollment general education courses to reach the most students. Additionally, some colleges are offering “low” and “no cost” course options to students and allowing instructors flexibility in use of content that is free to students without necessarily being openly licensed. These models suggest a priority on affordability rather than on the pedagogical transformation that may be enabled by openly licensed content. Future research should further explore the various affordances of OER and the extent to which open licenses enable improvements in course quality that in turn boost student achievement. This study provides evidence that institutional OER programs merit continued effort.



Introduction

Launched by Achieving the Dream (ATD) in 2016, the OER Degree Initiative sought to promote affordability and innovation at community colleges by supporting large scale OER adoption. Over two and a half years, the initiative supported 38 community colleges across 13 states in building degree pathways using only OER instructional materials. Eighteen of the grantees participated in multi-college consortia that received funding from the initiative.

SRI International, along with partner rpk GROUP, conducted the research and evaluation for the initiative, investigating the impacts of OER degrees on student success, the economic impacts on students and institutions, and facilitators and barriers to successful implementation of this model. In addition, ATD partnered with Lumen Learning to provide technical assistance to grantees and with the Community College Consortium for Open Educational Resources (CCCOER) to facilitate a community of practice.

This initiative took place in a broader context of growing interest and support for OER programs at the state and national level, as OER have emerged as a promising and potentially transformative solution to the problem of college affordability. For example, the New York legislature has allocated \$16 million to the State

Open Education Resources are digital materials that are freely available and openly licensed, allowing instructors and students to adapt, reuse and share them. OER can be any type of content including entire textbooks, assessments, articles, lesson plans, videos, and individual images. Software platforms such as interactive assessments can also be OER.

University of New York's (SUNY) and City University of New York (CUNY) systems to support OER work,³ in addition to funding the Open SUNY Textbooks (OST) program, which offers a curated selection of OER textbooks and courses at no cost through an online platform. The U.S. Department of Education and many states have launched #GoOpen initiatives to support broader adoption.⁴ The OER degree model was first pioneered at Tidewater Community College as a “Z degree” (indicating zero cost) and then spread across the state of Virginia and elsewhere. In 2016 the California legislature awarded over \$100 million in grants to support development of OER degrees through a “zero-textbook-costs” (ZTC) program at two dozen community colleges, and participants are reporting early though tentative signs of encouraging results.⁵

Research suggests that OER courses have the potential to save students money with the same or

³ Governor Cuomo Announces \$8 Million for Open Educational Resources Initiative at SUNY and CUNY to Cut High Cost of Textbooks. (2018, May 22). Retrieved from <https://www.governor.ny.gov/news/governor-cuomo-announces-8-million-open-educational-resources-initiative-suny-and-cuny-cut-high>. An additional \$8 million in funding is expected to be announced in February 2020.

⁴ GoOpen Network. (n.d.). Retrieved from <https://goopen.us/>.

⁵ Burke, L. (2019, September 19). Inside Higher Ed. Retrieved from <https://www.insidehighered.com/digital-learning/article/2019/09/19/california-community-colleges-implement-zero-textbook-cost>

modestly improved course outcomes.^{6,7} However, previous evidence is mixed and, in many cases, limited in terms of methodological rigor.^{8,9} There are several key challenges facing prior OER research: first, that “OER” covers a broad category of content, thus even well-designed studies can only provide evidence of efficacy for specific instructional materials, not for OER in general; second, that the effectiveness of OER materials, like any instructional materials or technology tools, varies widely depending on implementation and fit with the instructional goals and context; and third, reported cost savings of OER typically fail to account for either student purchasing behavior or increased costs incurred by instructors and institutions.¹⁰

The scale of the OER Degree Initiative created an opportunity to explore how OER adoption at scale affects students, instructors and institutions; the costs and benefits; and critical factors in ramping up and sustaining OER degree pathways. The research and evaluation addressed the following questions:

Academic outcomes

- Did students who took OER degree classes make greater progress toward degrees compared with similar students who take traditional classes?
- Were OER degrees more or less beneficial to particular subgroups of students (e.g., Pell Grant eligible)?
- What were the key moderators of effects on student outcomes?

⁶ Fischer, L., Hilton, J. I. I., Robinson, T. J., & Wiley, D. A. (2015). A multi-institutional study of the impact of open textbook adoption on the learning outcomes of post-secondary students. *Journal of Computing in Higher Education*, 27(3), 159-172.

⁷ Hilton, J., & Laman, C. (2012). One college's use of an open psychology textbook. *Open Learning*, 27(3), 265-272.

⁸ Gurung, R. A. R. (2018, November 14). Inside Higher Ed. Retrieved from <https://www.insidehighered.com/digital-learning/views/2018/11/14/what-we-dont-yet-know-about-open-educational-resources-opinion>

⁹ Shear, L., Means, B., and Lundh, P. (2015). Research on Open: OER Research Hub Review and Futures for Research on OER. Menlo Park, CA: SRI International.

¹⁰ Griffiths, R. J., & Maron, N. L. (2016, October 3). Open Educational Resources: Nearing an Inflection Point for Adoption? Retrieved from <https://www.nae.edu/162607/Open-Educational-Resources-Nearing-an-Inflection-Point-for-Adoption>

Economic outcomes

- How did enrolling in OER degrees impact costs for students?
- What were the start-up and ongoing costs for an institution to make the transition to OER degrees, including lost revenue streams? Is this model self-sustainable?
- What was the cost effectiveness of this model in terms of cost per student served and return on investment?

Implementation

- How many students and other stakeholders were impacted by the OER Degree Initiative?
- What were best practices, facilitators, and barriers associated with implementation of OER degrees?
- What impacts did OER degrees have on key stakeholders' experiences and on institutional culture?

Participating colleges began rolling out their OER degrees as early as fall 2016, though most began offering OER degree courses in spring 2017 and continued program development through the end of 2018. Grantee colleges typically aimed to convert at least one section of each of 20 courses required for specific associate degrees, though some colleges converted entire courses, and some developed more than one OER degree pathway. A requirement of the grant was that all OER degree courses be

certified by Lumen Learning as meeting open license standards.¹¹ In many cases colleges needed to revise courses that had been considered OER but that used proprietary content.

SRI's 2017 formative implementation report *Launching OER Degree Pathways: An Early Snapshot of Achieving the Dream's OER Degree Initiative and Emerging Lessons*¹² provides background of the OER movement, the ATD initiative, and participating institutions; presents findings from an instructor survey conducted early in the program; and reflects on sustainability issues. The 2018 formative implementation report *Participant Experiences and Financial Impacts: Findings from Year 2 of Achieving the Dream's OER Degree Initiative*¹³ provides additional insights into students' and instructors' perspectives and experiences with OER, drawing upon participant interviews and surveys, in addition to initial findings from cost analysis.

This final report presents findings from several new data collections and analyses, including the scale of the initiative, the academic and economic impacts, and instructor experiences and perspectives from a second iteration of the survey. In addition, this report will summarize or update selected findings from prior reports in order to provide a comprehensive picture of what we learned. The report is organized in six sections:

- **Scaling of OER Courses.** Data is presented on OER sections offered per institution across the

course of the grant, instructor participation, and student enrollment and completion.

- **Instructor Practices and Experiences with OER.**

This section explores new findings related to instructors' experiences developing and teaching OER courses, the impact of OER on their practice, and their beliefs around the sustainability and impact of the OER model.

- **Impact on Students.** This section summarizes previously reported findings related to students' awareness of OER course offerings, perceptions of the quality of OER materials and instruction, and beliefs around how OER will influence their ability to afford college.

- **Academic Impact.** This section presents new analysis on the impact of OER course taking on students' progress to degree in a sample of colleges.

- **Economic Impact.** Here we share data and analysis on the cost savings for students and start up and ongoing costs for institutions associated with launching OER degrees, as well as reflections on future costs and return on investment.

- **Summary and Implications for Future Direction.**

The report concludes with a discussion of implications of these findings for future OER programs and research, taking into account lessons learned about implementation of OER degree and opportunities for future progress.

¹¹ ATD required courses to use all openly licensed instructional content except in specific circumstances. For example, instructors can require students to purchase essential tangible goods, such as laboratory equipment for lab courses or art supplies for a studio course. Grantees are permitted to use copyrighted primary sources such as novels in required courses, but elective courses that use copyrighted material did not count towards the OER degree pathway. Grantees were permitted to charge fees for OER courses, but students must have unrestricted access to course materials from day one.

¹² Griffiths, R., Mislevy, J., Wang, S., Shear, L., Mitchell, N., Bloom, M., Staisloff, R., Desrochers, D. (2017). *Launching OER Degree Pathways: An Early Snapshot of Achieving the Dream's OER Degree Initiative and Emerging Lessons*. Menlo Park, CA: SRI International.

¹³ Griffiths, R., Gardner, S., Lundh, P., Shear, L., Ball, A., Mislevy, J., Wang, S., Desrochers, D., Staisloff, R. (2018). *Participant Experiences and Financial Impacts: Findings from Year 2 of Achieving the Dream's OER Degree Initiative*. Menlo Park, CA: SRI International.

Scaling of OER Programs

This section presents final data on the course offerings, instructor participation, and student enrollments at participating colleges from summer 2016 through the end of fall 2018, when the initiative concluded. Colleges provided these data after the end of each term at the section level. Note that we only include data for courses that were certified by Lumen as meeting license requirements of the grant; in some cases OER sections were reported by colleges but excluded here due to lack of certification.

Unless otherwise stated, the data presented in this section were reported by colleges. We have augmented these data from information collected through instructor surveys to provide a richer understanding of how the initiative unfolded.

Total OER Section Offerings

From 2016 to 2018, 29 participating institutions¹⁴ offered a total of 6,639 OER sections.¹⁵ The total number of section offerings increased steadily from term to term as institutions scaled OER courses, jumping from 177 in summer/fall 2016 to 2,828 in summer/fall 2018 (see Table 1). For OER section offerings by institution, see Appendix A. For OER enrollment by institution, see Appendix B.

On average, institutions offered 56 OER sections each term from summer/fall 2016 through summer/fall 2018, though these averages grew substantially over time as more OER courses were developed. Over this time period, institutions averaged a total of 229 OER sections. The total number of sections

Table 1. Overall OER Section Offerings and Enrollment

Term	Summer/ Fall 2016	Winter/ Spring 2017	Summer/ Fall 2017	Winter/ Spring 2018	Summer/ Fall 2018
OER Section Offerings					
Sites offering OER sections	8	24	28	27 ^a	28
Sections offered (total)	177	513	1,523	1,598	2,828
OER Section Enrollment (Overall)					
Students who enrolled at the start of course	4,511	12,522	36,975	38,078	67,906
Students who withdrew from course	581	1,298	3,474	3,743	6,128
Students who completed with a C- or better	2,938	8,944	26,463	26,108	49,805
OER Section Enrollment (Pell Eligible Students)					
Pell recipients who enrolled in course	2,059	5,503	15,336	15,836	26,056
Pell recipients who completed course with a C- or better	1,236	3,788	10,769	10,666	18,357

^aOne site reported delivering OER courses in spring 2018 but we were unable to confirm that they had been Lumen certified.

Sources: Section-level data.

14 The three Distance Minnesota schools and the five Alamo College campuses are counted here together as consortia; additionally, three other institutions (SUNY Mohawk Valley, VCC Tidewater, and VCC Mountain Empire) did not submit any data and are not included in this total.

15 As certified by Lumen Learning.

offered over the course of this project differed significantly by institution, ranging from 19 to 742 from 2016 to 2018. The number of sections offered per term varied similarly, ranging from one to 260 in a single term.

Institutions focused most of their efforts on converting introductory or gateway courses to OER; in the 2018 survey of instructors participating in the OER Degree Initiative, 91% of respondents indicated they were teaching introductory and/or gateway level courses (see Figure 1).

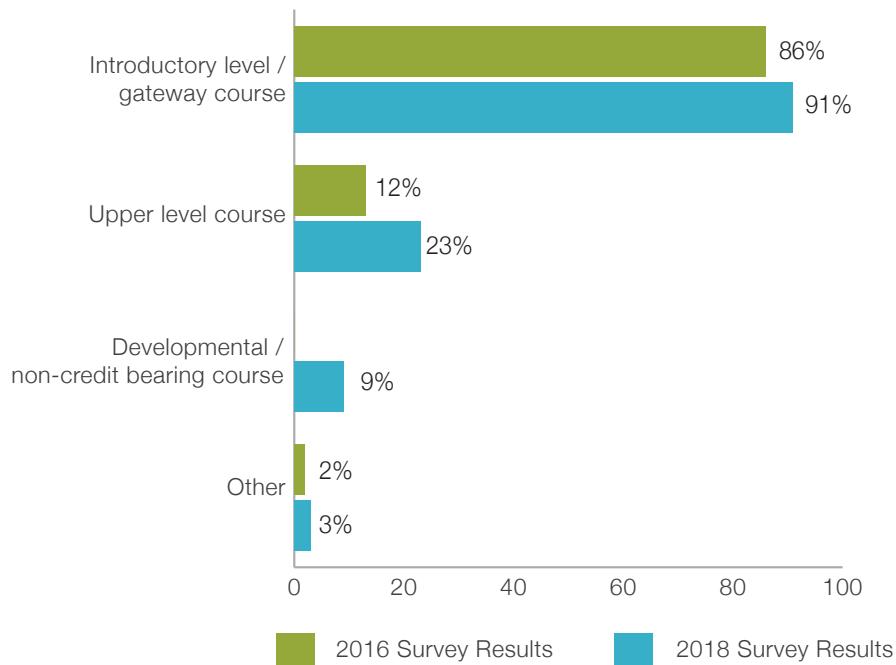
The OER Degree Initiative supported development of approximately 586 Lumen-certified OER courses. These covered a broad range of disciplines and advanced courses as well as introductory gateway courses. Twelve percent of instructors reported that their OER courses primarily consisted of newly created content, while 33% integrated existing OER from multiple sources.

Instructor Participation

During the grant period, a total of 1,949 instructors taught at least one section of an OER course through the program. This number grew steadily from term to term, both within and across institutions. In summer/fall 2016, a total of 81 instructors taught OER sections, with an average of 10 instructors per institution; by summer/fall 2018, this total grew more than tenfold to 1,222 (see Figure 2), with **an average of 42 instructors per institution**. Instructors taught on average two sections during each term they participated in the initiative.

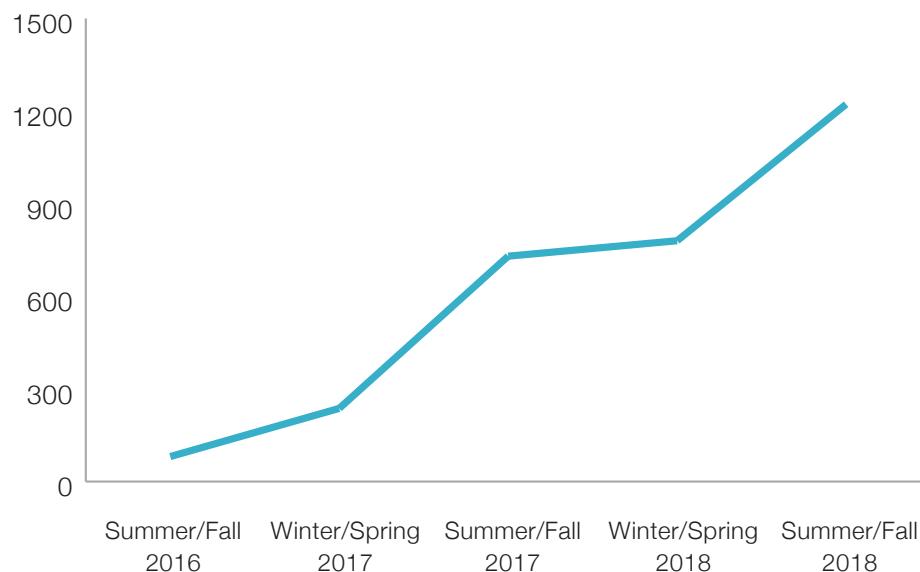
Instructors' subject areas varied. According to the instructor survey results, the largest share of instructors taught courses in health and STEM fields (25%), social science and psychology (21%), liberal arts and general studies (18%), and language and literature (17%) (see Figure 3).

Figure 1. Instructor Survey Results: OER Course Levels Taught



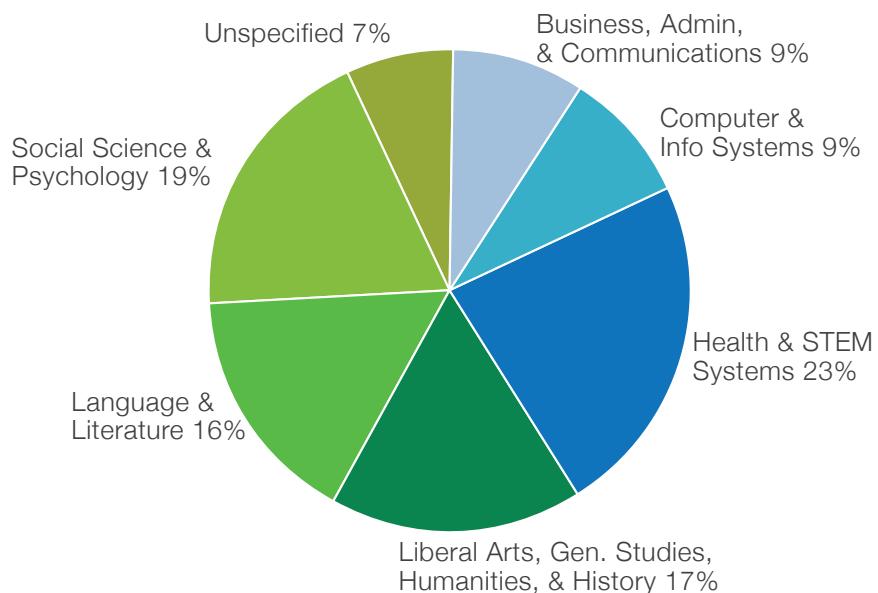
Sources: SRI 2016 instructor survey, SRI 2018 instructor survey.

Figure 2. Participating Instructors, by Term



Sources: Section level data.

Figure 3. OER Course Subjects



Sources: SRI 2018 instructor survey.

Student Enrollment

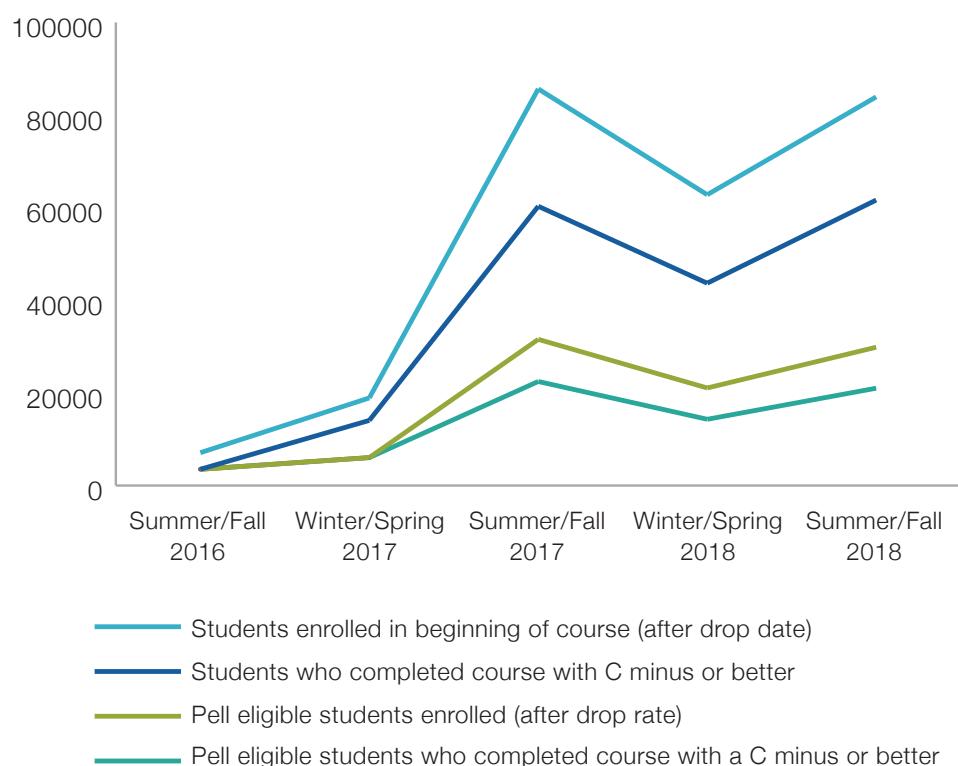
Approximately 160,000 students enrolled in Lumen-certified OER courses over the course of this grant. As institutions increased their OER section offerings over this time period, total enrollment also increased from term to term, jumping from 4,511 in summer/fall 2016 to 67,906 in summer/fall 2018.

At the institution level, an average of 5,517 students enrolled in OER courses per institution from summer/fall 2016 through summer/fall 2018. **The institution average enrollment grew from 569 in fall 2016**

to 2,425 in fall 2018, with an overall minimum of 37 enrollments per institution per term and an overall maximum of 6,065.

Of the 159,992 who enrolled in OER courses over the course of the initiative, over 115,679 completed their course with a C- or better (72%). Completion rates per course ranged from 44% to 97%. Roughly 40% of students (64,789) were designated as low-income (as determined by their eligibility to receive federal Pell grants). Of these Pell-eligible students, an estimated 45,200 (70%) completed the OER course with a C- or better (see Figure 4).

Figure 4. OER Enrollment and Completion



Sources: Section level data.

Instructor Practices and Experiences with OER

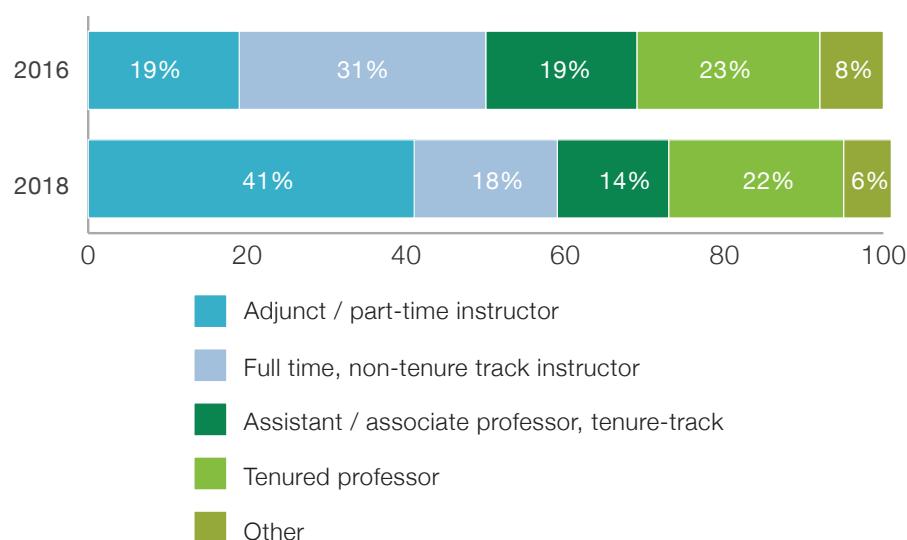
SRI conducted instructor surveys and interviews to investigate the impact of the OER Degree Initiative on instructor practices and experiences adopting and delivering courses using entirely OER.

The pool of instructors teaching OER courses changed drastically from the start to the end of the grant. As noted above, the number of instructors teaching OER courses through the program increased from 81 to 1,222 from fall 2016 to fall 2018. **During this time frame, the proportion of instructors who identified as adjunct/part-time increased from 19% to 41%** (see Figure 5). This increase is mirrored by a bump in the respondents describing their role in the initiative as teaching OER courses from 78% to 93%, while those describing their role as developing OER courses fell from 75%

to 49%. Altogether, these numbers suggest that **as institutions finalized development of OER courses, they scaled implementation of OER sections by assigning more OER sections to adjunct and part-time faculty.**

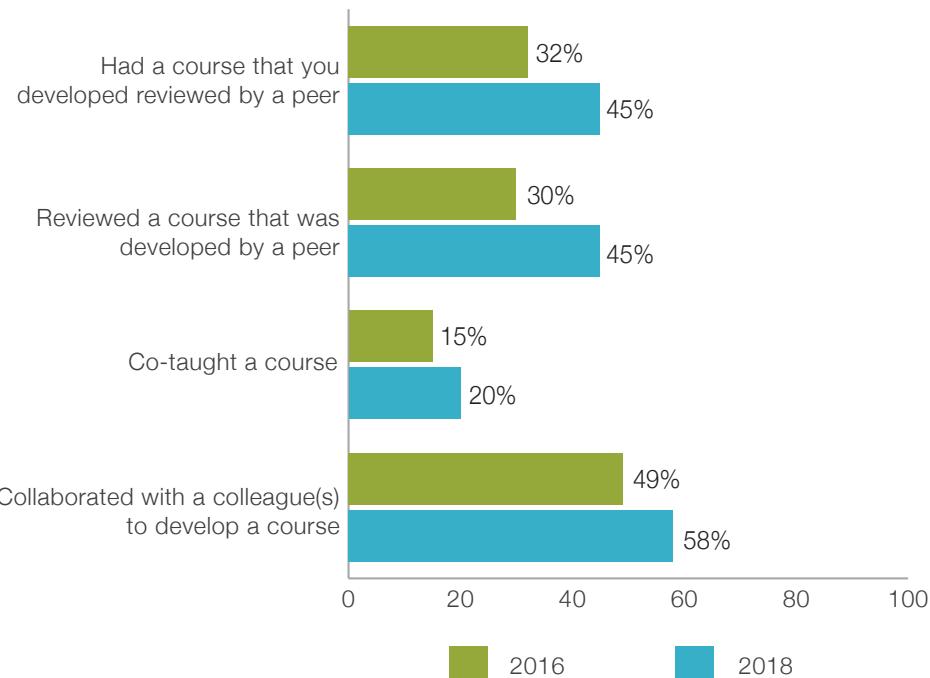
Additionally, survey findings indicate that **as OER grew more prevalent at participating institutions, instructors began to engage more directly with the OER content and with each other** (see Figure 6). From 2016 to 2018, the percentage of instructors who reported engaging in moderate to extensive adaptation of OER resources increased from 51% to 63%. The prevalence of all types of instructor collaboration in the respondent pool also increased in this time frame.

Figure 5. OER Instructor Roles



Sources: SRI 2016 instructor survey; SRI 2018 instructor survey.

Figure 6. Types of OER Instructor Collaboration



Sources: SRI 2016 instructor survey; SRI 2018 instructor survey.

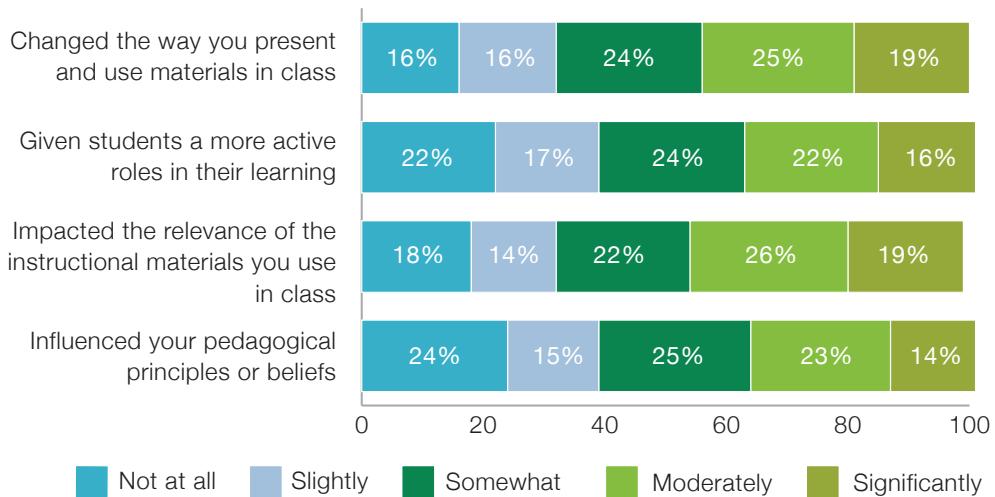
Despite this evidence of increased instructor engagement, not all instructors felt equally equipped to embrace OER. Instructors who reported high personal comfort with technology also reported greater influence of OER on their instruction, higher perceived sustainability of OER at their institutions, and higher likelihood of recommending OER to a colleague than their less tech-savvy peers. **While there is evidence that providing instructors with training had a positive impact on these outcomes, the proportion of instructors receiving training fell by 20% from 2016 to 2018**, probably because the share of instructors teaching OER courses that had been developed by other faculty members increased.

An overwhelming share of instructors believe the cost savings have a positive impact on students (90%), followed by ability to access materials (84%) and ease of use (78%). Smaller

shares expected students to benefit from the improved quality of course materials (71%) and different teaching approaches (57%). With regard to OER's classroom impact, **most instructors reported that OER had at least somewhat changed the way they presented and used materials in class, increased the relevance of those materials, and influenced their pedagogical beliefs overall** (see Figure 7). Additionally, 38% of instructors reported that their use of OER materials allowed them to give students a moderately or significantly more active role in their own learning.

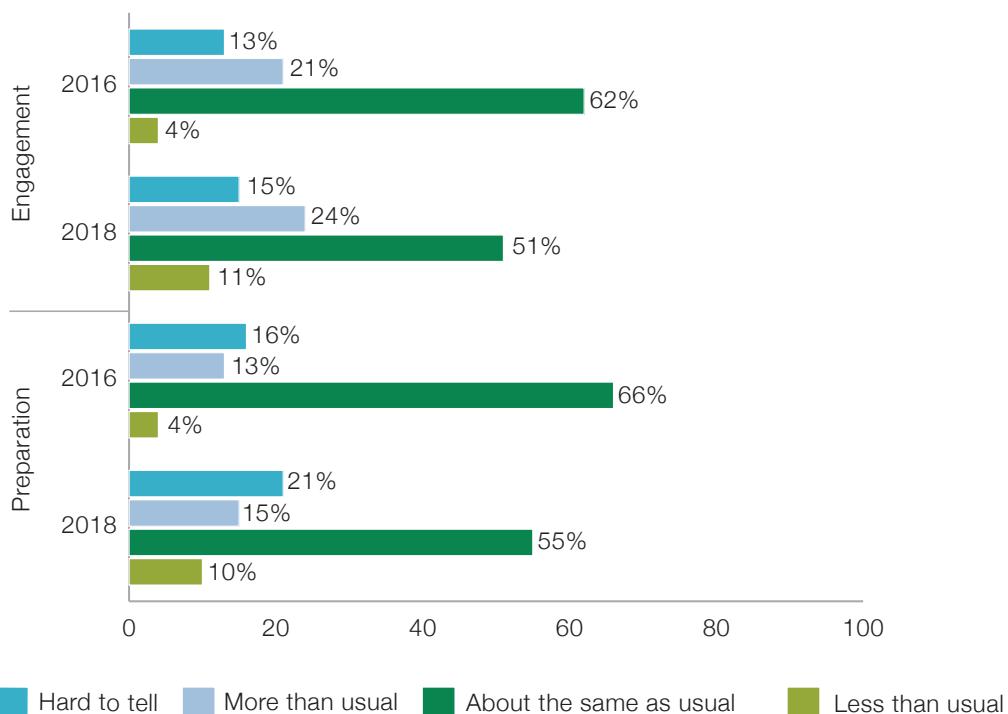
Most instructors did not report any perceived changes in student preparation, engagement, or outcomes in OER sections (see Figure 8). Thirty-five percent of instructors observed a slight or significant improvement in course outcomes.

Figure 7. Influence of OER on Instruction



Sources: SRI 2018 instructor survey.

Figure 8. Observed Differences in Student Preparation and Engagement in OER Courses



Sources: SRI 2016 instructor survey; SRI 2018 instructor survey.

Nevertheless, barriers persisted in scaling OER across these institutions. When asked to rate the significance of barriers on a scale of 1 to 4, **instructors' ratings for all barriers increased from 2016 to 2018.**

Significant barriers across both years included:

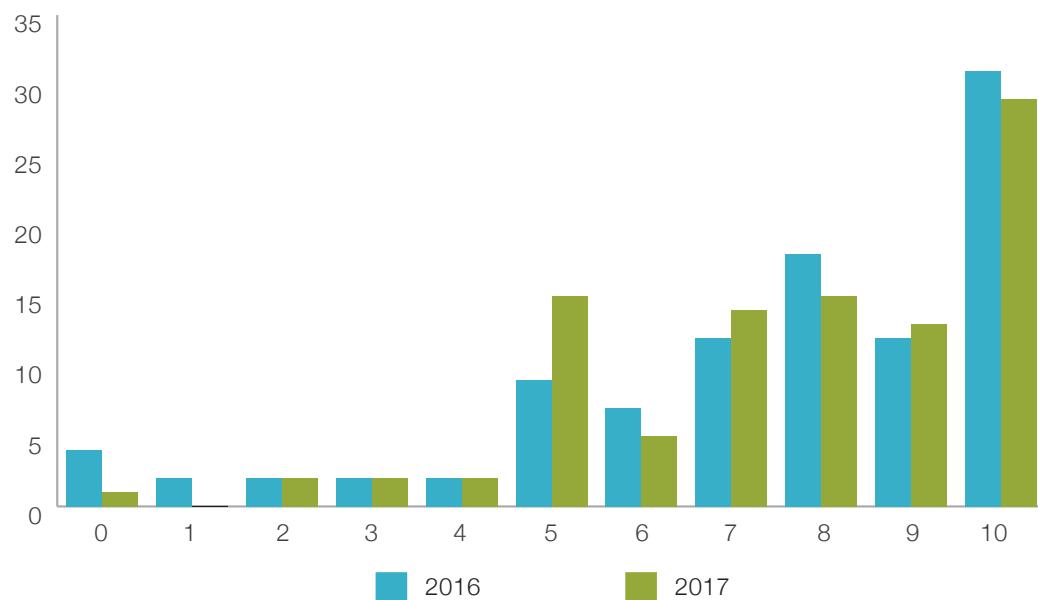
- Availability of suitable, high-quality OER;
- Lack of time, skills, and support in locating/vetting OER; and
- Ensuring that OER has appropriate licensing.

Despite these barriers, instructors overall felt positively about OER and they did not plan to go back. Both the 2016 and 2018 surveys included a question used to calculate the Net Promoter Score (NPS) for OER, a measure of the likelihood of an innovation spreading that is calculated by subtracting the number of respondents who are unlikely to recommend an innovation (rating of 0-6) from those who are very likely to recommend

it (rating of 9 or 10).¹⁶ The NPS for the survey pool was moderate in both 2016 to 2018 (13 and 16, respectively, on a scale of -100 to 100) (see Figure 9). Notably, the Net Promoter Score for those instructors who responded to both surveys increased from 20 in 2016 to 28 in 2018—indicating that these instructors' opinions of OER improved over the course of the initiative. **The majority of respondents in 2018 (83%) also indicated that for courses they had already taught as OER, they would not be returning to traditional methods.**

Most instructors believe OER programs are likely to be sustained on their campuses. Forty-three percent said OER degree pathways would “definitely” be sustained and an additional 48% said that they pathways may be sustained. Eighty-three percent reported that they continued using OER in courses that had been converted.

Figure 9. Instructors' Reported Likelihood of Recommending OER to a Friend



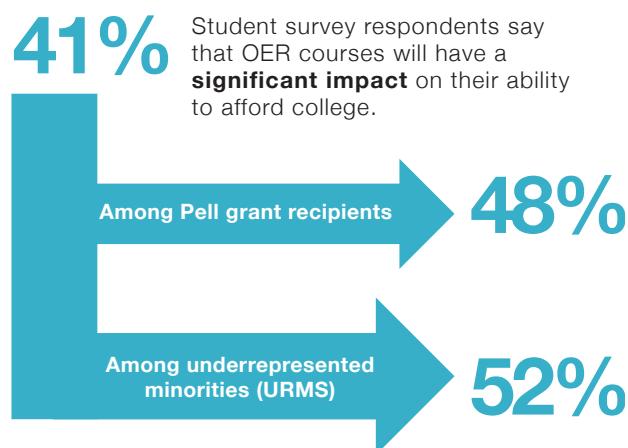
Sources: SRI 2016 instructor survey; SRI 2018 instructor survey.

16 For an explanation of the Net Promoter Score genesis and method, see Reichheld, F. F. (2003), *The One Number You Need to Grow*, Harvard Business Review, December issue. Retrieved from <https://hbr.org/2003/12/the-one-number-you-need-to-grow>.

Student Experience

To better understand how students experience the OER Degree Initiative, the research team compiled findings from student surveys, focus groups, and interviews at participating institutions. Findings from these data collections were reported in detail in our 2018 report *Participant Experiences and Financial Impacts*. We highlight some of the key findings here to present a comprehensive view of the initiative.

Figure 10. Impact of OER Courses on Student Progression and Retention



Source: SRI 2017 student survey.

One of the foremost ways OER courses impact students is by making college more affordable.

Textbook costs constitute a significant burden for college students—particularly those from low-income backgrounds—and can account for up to 80% of the academic costs for Pell or other grant recipients.¹⁷ In a 2017 survey of 2,441 students at 12 participating colleges, 41%



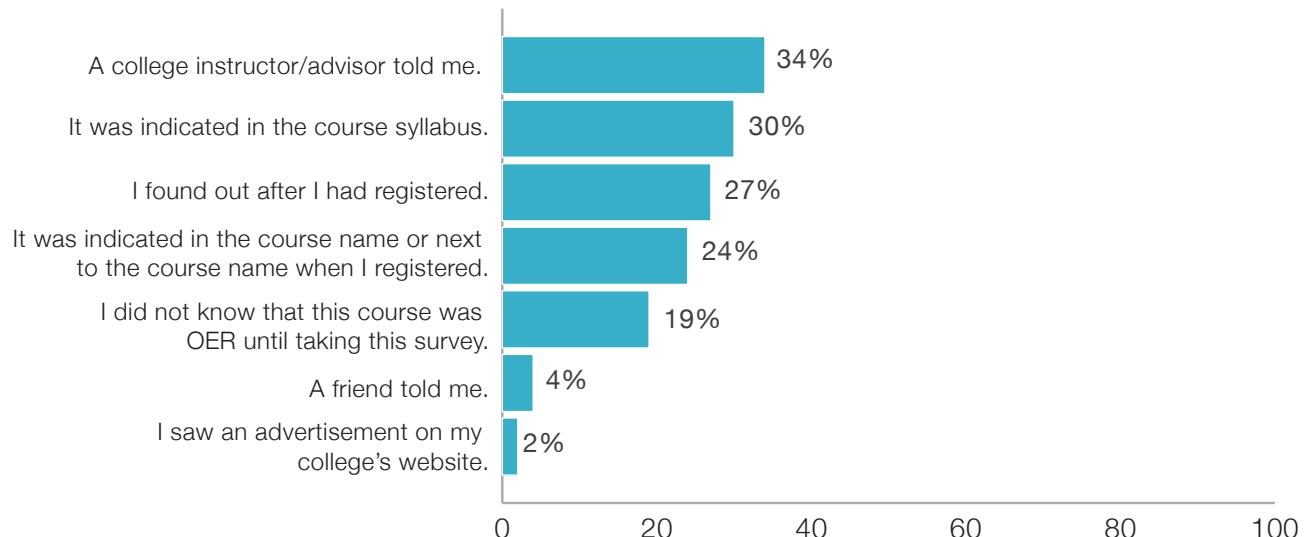
of students reported that OER courses would have a significant impact on their ability to afford college (see Figure 10). This was particularly true for students from underrepresented minorities or working students.

Reduced financial barriers may serve to increase students' academic progress, as **28% of students surveyed reported that they would use the money they saved with OER to take additional courses**, and 12% said they had withdrawn from a course because they could not afford the required materials. Fifty-three percent of students said they had not purchased required materials for a course, and the most frequent reason was cost. Students who work more hours (more than 20 hours per week versus less than 20 hours per week) were significantly more likely to report not purchasing required materials due to costs.

As of spring 2017, most students were still unaware of OER options and the OER degree initiative (see Figure 11). Over half of the students

¹⁷ Griffiths et al., 2018. rpk GROUP analyses reported in year 1 report.

Figure 11. How Students Learned Their Course was OER



Source: SRI 2017 student survey.

surveyed indicated that they did not realize their course was OER when they signed up (59%). Those that were aware reported choosing to enroll in an OER course largely because of major requirements (71%), with few citing advisor/faculty recommendation (23%) or friend/classmate recommendation (12%). Students participating in focus groups also indicated that they were not familiar with the term “OER degree pathway,” nor that their school offered such options. It is possible, however, that student awareness of OER course offerings increased in the final year of the program.

Students enrolled in OER courses reported having very positive experiences. In focus groups, students reported being pleased to learn they could immediately access materials and excited they were available online. Students also reported higher quality of learning in OER courses, and more

than 70% reported not having any problems using OER materials. Most students used OER materials electronically, rather than printing out materials or buying printed copies. While some students acknowledged constraints in technology/internet access, this did not emerge as a major barrier to OER usability.

Between fifty to sixty percent of students rated OER courses slightly higher or much higher than traditional courses in terms of student engagement, quality of instructional materials, quality of teaching, and quality of learning. Ultimately, over half (59%) of students who enrolled in an OER course reported that they were likely or very likely to enroll in another and to recommend the course to a friend. The Net Promoter Score for students was 39 on a scale of -100 to 100: considerably higher than for faculty.

Academic Outcomes for Students

A primary goal of the study was to determine, with as much confidence possible, whether the availability of OER degree options enabled students to progress more quickly towards attaining degrees. SRI investigated the following research questions:

1. Did students who took OER classes make greater progress towards degrees compared with similar students who took traditional classes?
2. Were OER degrees more or less beneficial to particular subgroups of students (e.g. Pell eligible)?
3. Was retention a key mediator of effects on student outcomes?

Overall, we found that students who took OER courses accumulated significantly more course credits than otherwise similar students in 6 of 11 colleges that participated in impact studies (“research partners”). The 6 colleges in which we found positive impacts were evenly split between “high dosage” and “low dosage” sites (see definitions below). **In most cases, we did not find significantly differential effects for low income or underrepresented minority students.** A meta-analysis of impact studies across the 11 colleges found a small positive effect (Hedge’s $g = .18$) on credit accumulation and no significant difference in cumulative GPA across sites. We also did not find significant relationships between students’ academic outcomes and other factors, such as the share of adjunct faculty teaching OER courses and the level of instructor satisfaction with supports provided by their college. It may be that a sample size of 11 colleges was not sufficient to detect modest underlying trends.

The academic impact findings described in this section have limitations that are important for readers to keep in mind (see Limitations, p. 35). Importantly, because student enrollment in OER courses was not assigned at random, these analyses cannot rule out the possibility that differences in outcomes reflect unobserved differences in students rather than the impact of OER course taking. In addition, **OER courses were rolled out more slowly than expected and generally not offered to students as explicit pathways, so in many cases relatively few students had cumulative exposure to a high “dosage” of OER courses.** We tried to mitigate these limitations with several statistical techniques, including using matching techniques to compare students with similar background characteristics and, in most colleges, controlling for the number of semesters that students were enrolled. The latter may result in underestimation of the benefits of OER courses to the extent that students who took OER courses were more likely to reenroll.

Study Design

In the first year of the study, SRI worked with research partners to determine the most rigorous study design possible for that site. An overview of the data sources, sample, and methods follows. Additional details on the technical approach are provided in Appendix D. Study design information each research site is available in a separate technical appendix.

Data Sources and Variables

SRI requested student-level data from 11 of the community colleges participating as research partners in the OER Degree Initiative. Specifically, we requested student demographic variables, a measure of prior academic achievement such as math

placement test scores, and transcript data. Given that the community colleges included in our sample are broad-access institutions, many do not require students to take standardized entrance exams such as the SAT or ACT. In cases where a pretest was not available, we created an ordinal measure of prior achievement using math course placement. SRI requested these data term-by-term for each semester included in the impact study time period. A complete list of the requested data elements is available in Appendix D, along with details of our data cleaning procedures.

Treatment and Control Conditions

We defined three levels of treatment for impact analyses (see Table 2). **We considered treatment students to have received a “high dosage” of OER courses if they enrolled in three or more OER courses. We considered treatment students to have received a “low dosage” of OER courses if they enrolled in either one or two OER courses.** Students in the control condition all received “no dosage” of OER courses. For the purpose of conducting the impact analyses, SRI did not require that the OER course be Lumen-certified.

As shown in Table 3, **a small proportion of students in the sample took four or more OER courses, ranging from 11% to less than 1% at**

Table 2. Criteria for No-, Low-, and High-dose OER Conditions

Condition	Number of OER courses
No-dose comparison	Zero OER courses
Low-dose treatment	1-2 OER courses
High-dose treatment	3 or more OER courses

several of the colleges. As much as 31% to 86% of the sample did not take any OER courses; these students served as the pool from which comparison students were identified.

SRI also worked with each research partner college to determine whether a concurrent comparison or historical comparison design would be most feasible in their institutional context. In the historical comparison design, we followed a cohort of students for a specified period of time following the launch of the OER Degree Initiative and compared them with a cohort of students who enrolled before the OER degree was launched, over the same number of semesters. In the concurrent comparison design, we followed students for a specified period of time following the launch of the OER Degree Initiative, and from this pool, identified those who completed one or more OER courses as treatment students and those who took zero OER courses as the comparison (see Figure 12). Several factors influenced study design choices, such as other known policy changes coinciding with the launch of the OER degree (which would interfere with historical comparisons) or whole course conversions (which would interfere with concurrent comparisons if all students have to take OER courses).

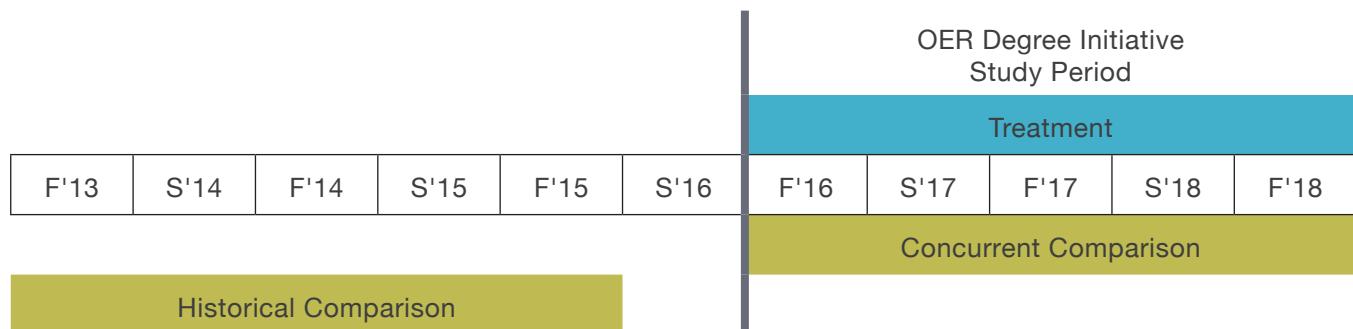
Eight of the 11 research partners used a concurrent comparison design and the remaining three used a historical comparison design. The starting term and number of terms for which we followed students varied by college depending on when they rolled out OER degree courses. **For some colleges with existing OER courses, we were able to follow students for as many as five fall/spring terms beginning in Fall 2016. For others who required more time to develop OER courses, we were**

Table 3. Number of Students Taking OER Courses, by College

College	Number of OER Courses Taken						Total
	0	1	2	3	4	5+	
Alamo Colleges	3,209	2,959	1,896	1,227	659	548	10,498
	31%	28%	18%	12%	6%	5%	100%
Austin CC	1,129	203	46	11	4	0	1,393
	81%	15%	3%	1%	0%	0%	100%
Bunker Hill CC	8,807	786	532	82	21	7	10,235
	86%	8%	5%	1%	0%	0%	100%
Borough of Manhattan CC	2,068	490	173	52	16	6	2,805
	74%	17%	6%	2%	1%	0%	100%
Central Virginia CC	2,979	709	480	238	161	141	4,708
	63%	15%	10%	5%	3%	3%	100%
Forsyth Tech CC	5,039	1456	658	227	76	33	7,489
	67%	19%	9%	3%	1%	0%	100%
Monroe CC	291	41	20	13	3	0	368
	79%	11%	5%	4%	1%	0%	100%
Montgomery College	673	338	160	68	32	11	1,282
	52%	26%	12%	5%	2%	1%	100%
Pierce CC	615	596	205	76	23	9	1,524
	40%	39%	13%	5%	2%	1%	100%
Santa Ana College	9,912	2,118	1,045	430	180	100	13,785
	72%	15%	8%	3%	1%	1%	100%
Herkimer College	4382	435	384	325	245	387	6158
	71%	7%	6%	5%	4%	6%	100%

Sources: Research partner student level data, SRI impact analysis.

Figure 12. Illustrative Example of Concurrent Versus Historical Comparison Designs



only able to follow students for as few as two or three terms, starting as late as Fall 2017 or Spring 2018.

Outcome Measures

SRI examined the impact of OER degrees on progress towards degree as measured by two student outcomes: college credits attained and cumulative college grade point average (GPA). All 11 colleges were able to provide student-level transcript data that allowed SRI to calculate credits accumulated over the study time frame. Nine of 11 provided sufficient data for SRI to calculate cumulative GPA.

Research Design Summary by College

Table 4 provides a high-level summary of the impact study design and data available from each of the participating sites. Additional details for each site are provided in a separate technical appendix.

Methods

We conducted a series of quasi-experimental impact studies to examine the extent to which enrollment in OER courses was associated with improved student outcomes as measured by college credits attained and cumulative college GPA.

Prior to analysis, we checked all cleaned datasets for baseline differences for students' prior achievement

Table 4. Research Partner College Study Design Elements

Site	Design	Low/High Dose Treatment	# Terms	Statistical Controls			Outcome Measures	
				Demogs.	Prior Achieve	# Terms	Cum. Cred	GPA
Alamo Colleges	Concurrent	High	4	✓	✓	✓	✓	
Austin CC	Concurrent	Low	5	✓	✓	✓	✓	✓
Bunker Hill CC	Concurrent	High	4	✓	✓	✓	✓	✓
Borough of Manhattan CC	Historical	Low	5	✓	✓	✓	✓	
Central Virginia CC	Concurrent	High	5	✓	✓	✓	✓	✓
Forsyth Tech CC	Concurrent	High	3	✓	✓	✓	✓	✓
Monroe CC	Historical	Low	2	✓			✓	✓
Montgomery College	Concurrent	High	3	✓	✓	✓	✓	✓
Pierce CC	Concurrent	Low	5	✓	✓	✓	✓	✓
Santa Ana College	Concurrent	Low	5	✓	✓		✓	✓
Herkimer College	Historical	High	4	✓	✓		✓	✓

and demographic variables in accordance with What Works Clearinghouse v4.0 Group Design Standards.¹⁸ **When the baseline difference between the treatment and control samples had an effect size greater than 0.25, we conducted propensity score matching (PSM) for impact analyses to produce a matched sample statistically equivalent at baseline.** Because we employed nearest neighbor matching with replacement, we calculated PSM weights to account for the number of times a given control student was matched with treatment students, and then applied these weights to all subsequent baseline checks and impact analyses.

We used ordinary least squares linear regression (OLS) for conducting our impact analyses. We included students' prior achievement, demographic variables, and transcript variables as statistical controls in our models. We report treatment effect sizes as Hedges' g when treatment effects are statistically significant.

We also conducted subgroup analyses for low-income students (i.e., students coded as "Yes" on Pell status) and for underrepresented minority students (i.e., students racially/ethnically identifying as African American/Black, American Indian/Alaska Native, Hispanic, Pacific Islander/Hawaiian Native, two or more races/ethnicities, or other) by adding interaction effects to the model.

Because of the differences among the OER initiatives and the institutions rolling them out, we chose to produce impact estimates for individual colleges and

then use a meta-analytic approach to summarize findings across datasets, as opposed to combining the data in a single analysis. This approach also allowed us to explore factors that are associated with the size of the impact in different implementations.

Results

Below we present the demographic characteristics of the final analysis samples, followed by results of the primary impact analyses, subgroup analyses, and mediation analyses.

Who Was Involved in the Study?

Table 5 presents the characteristics of the final analysis samples for each site in terms of size and student demographics. These data are for the matched samples, after propensity score matching was used to establish baseline equivalence between the treatment and comparison conditions. **The sample size available for analysis ranged considerably across the 11 colleges, with some having samples in the low hundreds and others approaching 5,000.** With the exception of one site, the average student age was around 20 years old. At least a third or more of the sample at each college consisted of students eligible for or who had received Pell grants. The proportion of students from historically underrepresented ethnic minority groups ranged considerably across colleges from 25% to 88%.

¹⁸ What Works Clearinghouse. (2017). Procedures handbook, version 4.0. Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, What Works Clearinghouse. Retrieved from https://ies.ed.gov/ncee/wwc/Docs/referenceresources/wwc_procedures_handbook_v4.pdf

Table 5. Demographic Characteristics of the Final Analysis Samples, by College¹⁹

College	Student Characteristics	Control (0 OER courses)			Low (1-2 OER courses)			High (3+ OER courses)		
		N	M	SD	N	M	SD	N	M	SD
Alamo Colleges	URM	2,068	.78	.41				2,191	.81	.39
	Pell status	2,068	.59	.49				2,191	.63	.48
Austin CC	URM	420	.65	.48	152	.67	.47			
	Pell status	na	na	na	na	na	na			
Bunker Hill CC	URM	306	.70	.46				65	.72	.45
	Pell status	306	.76	.43				65	.77	.42
Borough of Manhattan CC	URM	1048	.89	.31				574	.89	.31
	Pell status	1048	.38	.49				574	.38	.49
Central Virginia CC	URM	280	.25	.44				161	.27	.44
	Pell status	280	.45	.50				161	.49	.50
Forsyth Tech CC	URM	565	.37	.48				140	.36	.48
	Pell status	565	.40	.49				140	.39	.49
Monroe CC	URM	93	.25	.44	59	.25	.44			
	Pell status	93	.59	.50	59	.56	.50			
Montgomery College	URM	171	.70	.46				76	.64	.48
	Pell status	171	.48	.50				76	.47	.50
Pierce CC	URM	168	.35	.48	192	.31	.46			
	Pell status	168	.34	.47	192	.32	.47			
Santa Ana College	URM	2993	.88	.33	2141	.84	.36			
	Pell status	2993	.51	.50	2141	.51	.50			
Herkimer College	URM	1289	.38	.48	681	.38	.48			
	Pell status	1289	.69	.46	681	.67	.47			

Sources: Research partner student level data, SRI impact analysis.

¹⁹ M indicates “mean” or average. SD indicates Standard Deviation, a measure of the variation within a group. For each college we analyzed results for students who received high dosage where sample size permitted, otherwise we analyzed results for students who received low dosage of OER courses.

Relationship Between OER Course Taking and Credit Accumulation

In 6 of the 11 colleges, treatment students taking OER courses accumulated significantly more course credits than those who had not taken any OER courses (see Table 6). The number of additional credits accumulated by treatment students ranged from 2 to 8 across these six schools. In the remaining five colleges, students' credit accumulation in the two conditions was not statistically different after controlling for differences in student characteristics.

Table 6 also shows the estimated effect size for each of the research partners on credit accumulation. An effect size is a standardized measure of the magnitude of an effect and is calculated as the

standardized mean difference between two groups. The effect size increases in magnitude as the difference between the groups on the outcome measure get larger. The U.S. Department of Education's What Works Clearinghouse defines effect sizes equal or greater than 0.25 as substantively important, regardless of their statistical significance.²⁰ In our case, substantive importance equates to the treatment students taking at least one more course (3 credit hours) on average than the comparison students. **The estimated effects for 3 of the 11 colleges exceed this threshold (Colleges E, H, and J), and a fourth approaches it (College A).**

The forest plot in Figure 13 presents individual estimates and their confidence intervals for each site as well as the aggregate estimate across sites. Each blue circle represents the estimated impact of

Table 6. Credit Accumulation Results, by College

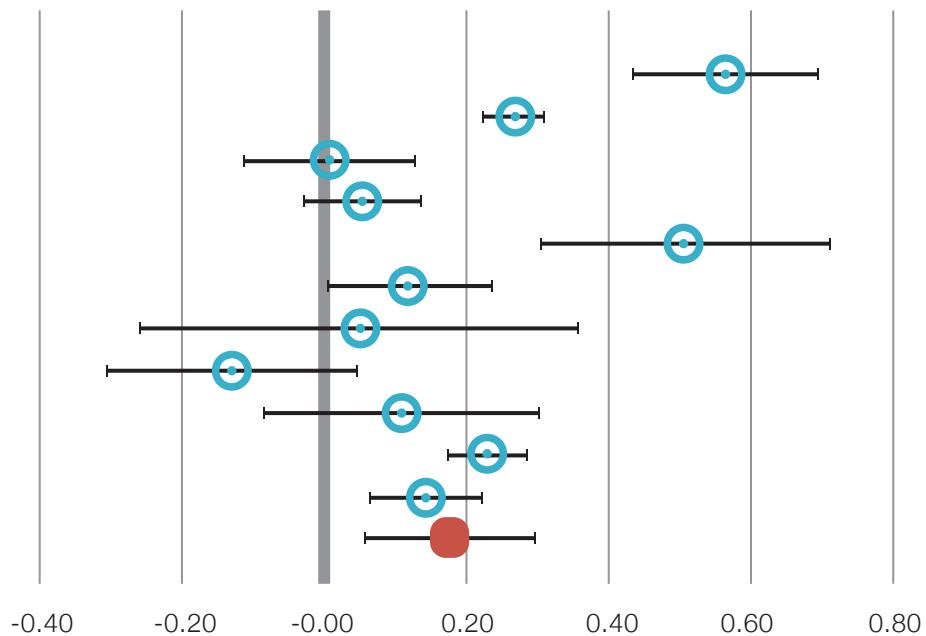
Site	Dosage	Credit	SE	p value ^a	ES
Alamo Colleges	High	3.14	0.39	<.0001	0.23
Austin CC	Low	1.88	0.94	0.046	0.12
Bunker Hill CC	High	1.75	1.61	0.28	0.11
Borough of Manhattan CC	Low	2.44	0.69	<.0001	0.14
Central Virginia CC	High	7.90	0.94	<.001	0.56
Forsyth Tech CC	High	-3.37	2.30	0.14	-0.13
Monroe CC	Low	1.26	4.07	.758	0.05
Montgomery College	High	7.30	1.50	<.001	0.51
Pierce CC	Low	0.13	1.33	0.92	0.01
Santa Ana College	Low	5.16	0.43	<.001	0.27
Herkimer College	High	1.05	0.82	.201	0.05

^aWe used a threshold of $p < .05$ for significance.

Sources: Research partner student level data, SRI impact analysis.

20 What Works Clearinghouse. (2017). *Procedures handbook, version 4.0*. Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, What Works Clearinghouse. Retrieved from https://ies.ed.gov/ncee/wwc/Docs/referenceresources/wwc_procedures_handbook_v4.pdf

Figure 13. Estimated Impact on Cumulative Credits, by Institution



Sources: Research partner student level data, SRI impact analysis.

OER degrees on cumulative credits in terms of effect sizes (Hedge's g). The length of the horizontal line through the circle represents the 95% confidence interval around the impact estimate. The longer the line, the more uncertainty there is around the true impact of the OER degree. The degree of uncertainty is influenced by several factors, including but not limited to the size of the sample used to produce the estimate. The red box at the bottom of the graph displays the grand mean and confidence interval of the included studies. Positive findings to the right of the bolded 0.00 line indicate that the number of credits accumulated was higher for students taking OER courses, while negative findings to the left mean that students in the no OER comparison condition earned more credits. A confidence interval that crosses the 0.00 line indicates that the estimated impact was not statistically significant from zero,

which is the case for 5 of the 11 colleges. **The estimated impacts for the remaining six colleges were positive and statistically significant. Across the 11 colleges, we found a small positive effect (Hedge's g = .18) on credit accumulation.**

Figure 13 reveals that **there was considerable variability across the colleges, suggesting the need to look more deeply into the conditions and practices associated with more and less favorable outcomes for OER degree implementations.**

To further explore the circumstances under which OER degrees were effective, we coded each impact study for the conditions under which the OER degree was implemented. These features included institution size, the share of instructors reporting that they volunteered to teach OER courses, adjuncts, reported leadership support,

availability of training, and Net Promotor Score, an indicator of overall instructor satisfaction with their experience adopting OER.

In addition, we tested whether study design features were associated with the effect size, including the type of comparison group, the number of semesters included in study time period, and whether we controlled for the number of semesters.

Across colleges, none of these variables was found to be a statistically significant moderator of OER degree impacts on cumulative credits.

Failure to find any implementation conditions or study design features that moderated OER degree impacts suggests that the sample of studies in our analysis may have had limited variability in terms of these practices or that the influence of practices is relatively weak and can be detected only with larger samples of studies. It is also possible that underlying trends were offset by individual outliers.

Relationship Between OER Course Taking and Students' Cumulative GPA

Nine of the 11 colleges provided sufficient data to calculate students' cumulative GPA. Of those, **treatment students taking OER courses achieved a significantly higher GPA than those who had not taken any OER courses at just one college; results approached statistically significance at a second. The results were negative and statistically significant in two others**, such that control students had a higher GPA than students taking OER courses, on average, by about half a letter grade. **In the remaining five colleges, students' cumulative GPA in the two conditions was not statistically different after controlling for differences in student characteristics.**

Table 7. Cumulate GPA Results by College

Site	Dosage	GPA	SE	p value ^a	ES
Alamo Colleges	High	NA	NA	NA	NA
Austin CC	Low	0.052	0.10	0.589	0.050
Bunker Hill CC	High	-0.029	0.13	0.830	-0.029
Borough of Manhattan CC	Low	NA	NA	NA	NA
Central Virginia CC	High	0.000	0.12	1.000	0.000
Forsyth Tech CC	High	-0.157	0.08	0.048	-0.175
Monroe CC	Low	0.159	0.11	.164	0.223
Montgomery College	High	0.214	0.11	.060	0.239
Pierce CC	Low	-0.437	0.11	<.001	-0.398
Santa Ana College	Low	0.187	0.03	<.001	0.191
Herkimer College	High	0.014	0.04	.731	0.015

^a We used a threshold of $p < .05$ for statistical significance.

Sources: Research partner student level data, SRI impact analysis.

Figure 14 shows the estimated effect size for each of the research partners on cumulative GPA. The overall effect size for the estimated impact on cumulative GPA across the nine sites was near zero and not statistically significant (Hedge's $g = .01$). With statistically significant results for only three institutions, and cumulative GPA as an available outcome for only 9 of the 11 colleges, we did not explore potential factors associated with more and less favorable outcomes.

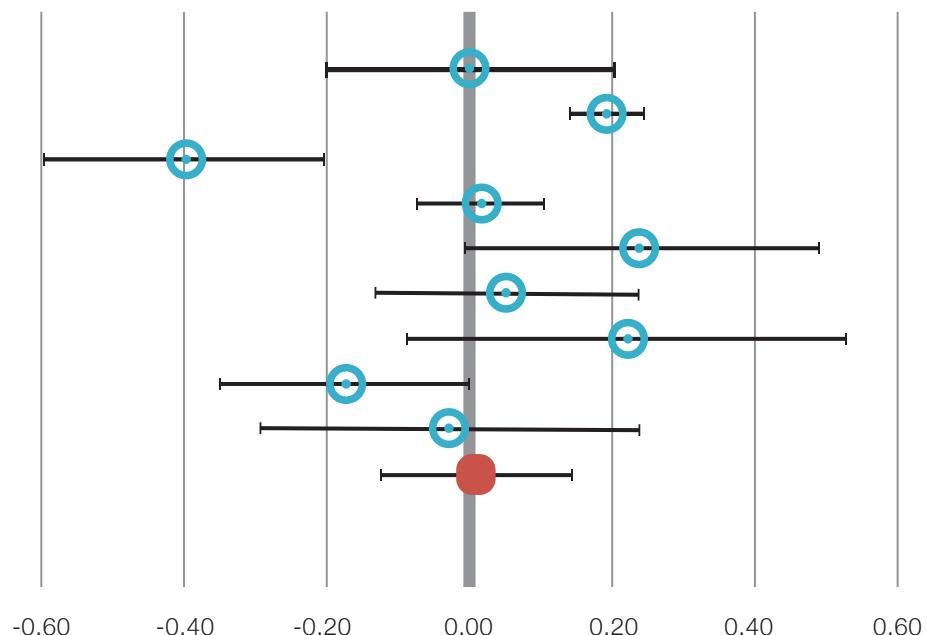
While our study found little to no impact of taking OER courses on students' cumulative GPA, coupled with the positive findings for credit accumulation, **these results suggest that students are maintaining their GPAs despite taking more courses, on average.**

Analysis of Effects by Subgroup

For sites with significant impacts overall, we conducted subgroup analyses to explore the extent to which enrolling in OER courses may have different impacts on (a) underrepresented minority (URM) students²¹ and (b) Pell-eligible and/or Pell-receiving students. Table 8 provides the results of the subgroup impact analyses.

In three of the six sites with statistically significant impact on credit accumulation overall, this difference also appears to be associated with Pell status. For two of the colleges, Pell students appear to have benefitted even more. In other words, the number of credits earned by Pell students taking OER courses relative to their Pell-eligible peers

Figure 14. Estimated Impact on Cumulative GPA, by Institution



Sources: Research partner student level data, SRI impact analysis.

²¹ To obtain greater statistical power, African American, Latino, Native American, and multiracial students were combined for subgroup analyses.

Table 8. Estimated Impact of OER Degrees on Cumulative Credits and GPA, Overall and By Subgroup

SITE	Cumulative Credits					Cumulative GPA				
	Overall	Pell	Non-Pell	URM	Non-URM	Overall	Pell	Non-Pell	URM	Non-URM
Alamo Colleges	3.14	—	—	2.82	4.40	na	na	na	na	na
Austin CC	1.88	—	—	—	—	—	—	—	—	—
Bunker Hill CC	—	—	—	—	—	—	—	—	—	—
Borough of Manhattan CC	2.44	3.99	1.37	—	—	na	na	na	na	na
Central Virginia CC	7.90	5.12	10.19	—	—	—	—	—	—	—
Forsyth Tech CC	—	—	—	—	—	.16	—	—	—	—
Monroe CC	—	—	—	—	—	—	—	—	—	—
Montgomery College	7.30	—	—	—	—	—	—	—	—	—
Pierce CC	—	—	—	—	—	-0.44	—	—	—	—
Santa Ana College	5.16	6.89	3.38	—	—	0.19	0.30	0.07	—	—
Herkimer College	—	—	—	—	—	—	—	—	—	—

Notes: — = not significant; na = not available

Sources: Research partner student level data, SRI impact analysis.

was significantly higher than the number of credits earned by non-Pell students taking OER courses relative to their non-Pell-eligible peers. In one site with statistically significant difference in credit accumulation, non-URM students benefitted more than URM students.

In the two sites with statistically significant impact on cumulative GPA, this difference was positively associated with Pell status for one of the sites. Here, Pell-eligible students enrolled in one or two OER courses earned GPAs of 0.30 points greater than otherwise similar students whereas non-Pell-eligible students enrolled in one or two OER courses had GPAs 0.07 points greater than otherwise similar students. Racial/ethnic identity was not associated with whether OER course enrollment affected cumulative GPA for either of the sites.

Our observation of few significant interaction effects means that OER degree programs were generally benefitting different groups of students to a similar degree, and in a few cases, Pell students may have benefitted more.

What Other Factors Might Have Influenced These Results?

In order for students to have achieved the low- or high-dosage threshold for the OER treatment, students by definition must have been retained for at least some period of time and accumulated at least some credits. And students who are retained for longer periods of time are likely to earn more credits, be they OER or non-OER course credits. SRI conducted several analyses to better understand the potential influence of retention on credit

accumulation, and the extent to which retention may mediate the influence of OER degrees on cumulative credits.

In 8 out of 11 of the impact analyses, we found that number of semesters in which students enrolled was significantly associated with credit accumulation and cumulative GPA. As such, **we opted for a conservative approach of controlling for the number of semesters in which students were enrolled in the academic impact analyses.** This approach reduces the risk that students received the treatment as a result of longer retention (giving them the opportunity to take more OER courses), but conversely raises a risk that the benefits of OER course taking are underestimated, given that OER use is theorized to positively effect retention.

We also explored the point(s) in their academic trajectory when students took their OER courses. If, for example, students did not take OER courses until the last term of our study period, it would be difficult to attribute their retention to taking OER courses. However, if students took OER courses early in their enrollment, or steadily throughout their enrollment, this explanation may be more plausible.

For illustration, we examined the average number of OER courses students with one or more OER courses completed in each term at one of the colleges. As shown in Table 9, students took OER courses at a relatively steady rate throughout the study time period. This suggests that retention did not systematically precede OER course taking in time.

Limitations

Our analyses sought to account for student factors that might influence differences in cumulative credits and GPA between students taking OER courses and those who did not. However, the regression models could only account for factors for which we could obtain data, such as prior test scores and student demographics. **Even after accounting for these factors, there are likely other important differences between students in the OER and control conditions that this study could not address.** For example, the study did not include data on student characteristics such as self-motivation, self-discipline, and time management skills. Therefore, the correlations reported in this study may be attributable, in part, to these unmeasured factors.

Table 9. Mean Number of OER Courses Taken Per Term (College E)

Term	1 OER course (n = 149)	2 OER courses (n = 58)	3 OER courses (n = 27)	4 OER courses (n = 14)
Spring/Summer 2017	0.7	1.0	1.4	0.9
Fall 2017	0.1	0.5	0.4	0.6
Spring/Summer 2018	0.1	0.4	0.7	1.9
Fall 2018	0.0	0.1	0.4	0.6

Sources: Research partner student level data, SRI impact analysis.

Similarly, when the study time period differs for the treatment and control groups—which is the case for 3 of our 11 research partners utilizing historical comparison designs—time is a confounding factor. We took important changes into account when we selected historical designs but could not account for all possible differences. Thus, we cannot rule out the possibility that estimated impacts are caused by other factors, such as the adoption of new institutional policies, the launch of other student success initiatives, etc.

The original design for this study defined the treatment as students enrolling in at least four OER courses during the applicable time window for an impact study. Due to implementation challenges across the initiative, community colleges did not roll out pathways of OER courses as expected with respect to both (a) the schedule of rollout and (b) the marketing and provision of sequences of pathway courses to students. Accordingly, students tended to enroll in OER courses on an ad hoc basis, and few students enrolled in four or more OER courses during the study period. Given these implementation challenges, we had to reevaluate the dosage threshold and redefined two levels of treatment for the purpose of the impact analyses (low-dose as one or two OER courses and high-dose as three or more OER courses). This ultimately limited our ability to test the cumulative impact of OER courses.

Relatedly, we had originally planned to limit the impact analyses to students who had declared a major in the degree in which the college developing an OER pathway. Because in practice the OER courses were not typically rolled out as pathways, majors became less relevant. We ultimately chose not to apply this major restriction to better capture the range of students participating in OER courses across majors.

Lastly, because of the way the treatment condition was defined, to achieve a dosage of OER courses, students needed to be retained long enough and accumulate credits—two of the outcomes OER degrees are hypothesized to affect. Because students were not randomly assigned to OER courses, it is not possible to disentangle the effect of retention on credit accumulation from the effect of OER degrees on credit accumulation. Empirically testing the mediation effects via the instrumental variables approach, for example, would require that the condition of temporal precedence is met. That is, we would need guarantee that OER course taking preceded retention, and retention in turn preceded credit accumulation in time—something that is not possible given the current study design and relatively small sample of students who took OER courses during the earlier terms in the study period at some sites.

Implications

Ultimately, **the positive associations between OER course taking and credit accumulation observed in this study are encouraging and suggest this approach merits further application and study. At the same time, it is difficult to determine whether the observed differences are caused by the availability of OER courses or some other factor such as student motivation.**

Further application and study is warranted to gain greater confidence about the effects of various factors.

Economic Impacts

We investigated the economic impacts of OER degree programs on students and institutions. We found that colleges' investments in OER have led to positive financial outcomes for students and for some of the colleges studied. After taking into account student purchasing patterns and incidental OER costs, **students' savings averaged at least \$65 per OER course by eliminating the need to purchase commercial textbooks and other course materials (see Table 10).**

The colleges' cost of developing an OER pathway averaged \$70 per OER enrollment, with the "unit cost" (i.e. cost per student enrollment in OER courses) declining to \$21 by the last

term of the initiative. These costs were primarily driven by instructor time used for OER course development. The transition to no- or low-cost courses only modestly reduced the revenue colleges received from their campus bookstores, with the average reduction less than 4%.

At the same time, our analysis suggests that investments in OER at some colleges was associated with an increase in average student credit hours attempted, generating additional revenue for institutions. We estimate that changes in credits attempted had a financial impact that offset OER development costs at 3 of the 5 cost partner colleges and generated positive net revenue for two of those

Table 10. Summary of OER Financial Impacts 2.5 Years (Fall 2016–Fall 2018)

	Aggregate	College Average	Average Per OER Enrollment
Grantee Colleges (N = 32)			
Student Savings ^a <i>(minimum, net of fees and printing costs)</i>	\$10.7m	\$334k	\$65
Bookstore Commission/Profit	(\$725k)	(\$27k)	(\$4)
Cost Partner Colleges (N = 5)			
Program Costs ^b	\$2.9m	\$576k	\$70
Return on investment (ROI) from Additional Credits Attempted ^c			
Net financial impact	\$188k	\$38k	\$5
ROI (%)		3%	
ROI (\$)		\$1.03	

^a Student savings accrue to students and therefore do not "offset" program costs; data should not be interpreted or presented as offsets.

^b Program costs and ROI are only available for the five cost partner institutions; aggregate data is not comparable to student savings and bookstore data presented for the full cohort of colleges.

^c ROI calculations include all five cost partner colleges, including two colleges that had no demonstrated impact on credit hours attempted. The net financial impact is calculated as gross revenues minus total costs (which includes OER program costs and additional instructional delivery costs associated with credits attempted). ROI is calculated as the net financial impact divided by total costs, or alternately, gross revenues divided by total costs.

Sources: Institutional cost data, cost partner data, SRI student impact analysis; rpk GROUP analysis.

institutions. When the impacts across all five cost partners are considered, the additional revenue from credit hours attempted was estimated to generate, on average, \$1.03 in gross revenue for every dollar spent (program and additional delivery costs)—a 3% return on investment that averaged \$38,000 across the five colleges.

The economic analysis investigated the following research questions:

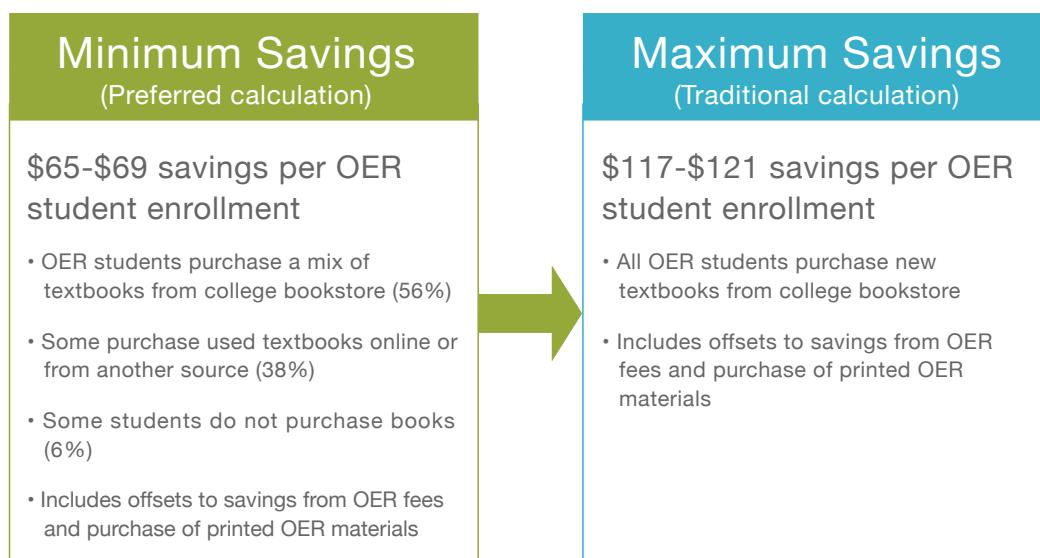
1. How did enrolling in OER degrees impact costs for students?
2. What were the start-up and ongoing costs for an institution to make the transition to OER degrees, including lost revenue streams? Is this model self-sustainable?
3. What was the cost effectiveness of this model in terms of cost per student served and return on investment?

Some of these analyses were presented in earlier reports and are summarized and/or updated here to provide a comprehensive view of the economic impacts.

Student Savings from Enrolling in OER Pathway Courses

Student savings are often the primary motivation for colleges to invest in OER degrees and are the most visible benefit to students. In order to investigate these savings, we combined information that grantees provided on OER enrollments, textbook prices, and bookstore sales to generate estimates of average student savings from taking OER courses. After considering students' textbook purchasing patterns, **student savings are estimated to average \$65 or more per OER course when students were no longer asked to purchase commercial textbooks or other course materials** (see Figure 15). This computation of student savings

Figure 15. Student Savings per OER Course, 2.5 Years (Fall 2016–Fall 2018)



Sources: Institutional cost data, SRI 2017 student survey; rpk GROUP analysis.

also takes into account additional incidental costs associated with OER courses at some colleges—such as course fees or optional printed OER textbooks or course materials.

These savings estimates reflect the minimum average savings to students when their typical purchasing patterns are considered, including the types of books they purchase (new, used, rental and digital) and the places they purchase them (college bookstore or online). Because not all students purchase new textbooks (a common assumption in many analyses of textbook cost savings), this study calculated a blended price to incorporate different types of books that students purchase, including used, rental, and digital materials.²² **The blended price for these materials averaged \$89 for all bookstore sales, or \$83 for traditional sections of courses that also had OER sections.** The savings estimates also reflect the reduced cost to students from purchasing used books online or not purchasing books at all.

Student surveys at the grantee colleges showed only **56% of students purchased textbooks from the campus bookstore** while 38% of students usually look for lower-cost alternatives from online retailers or other sources, which often provide greater access to lower-priced used books. About 6% of students typically don't purchase textbooks, with some of those students borrowing materials from the library or from friends and classmates.

The student savings shown incorporate offsets to savings for incidental OER costs. **Seven grantee colleges reported that their colleges levied OER fees,** representing 18% of all certified OER course sections offered during the grant period. These fees

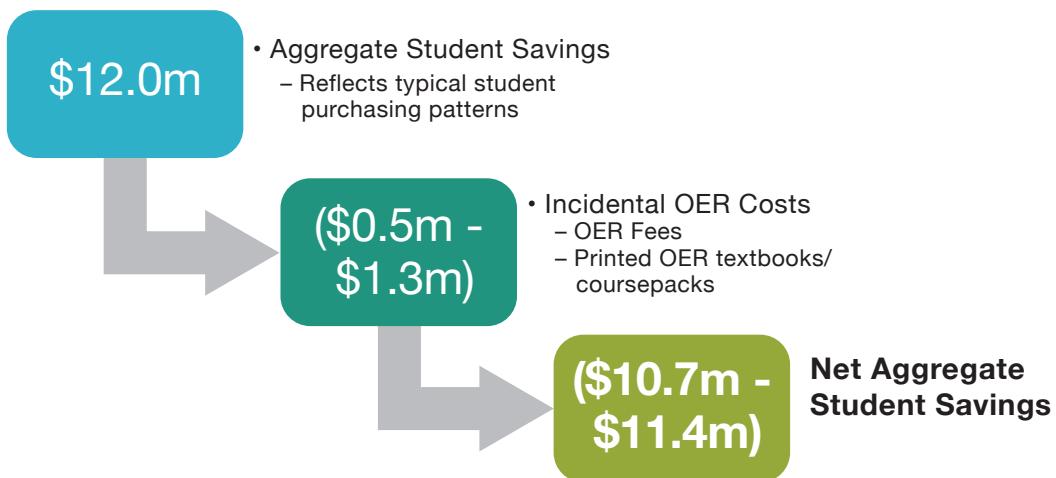
included college-wide fees charged in all OER course sections, as well as course-specific fees that colleges may charge for certain OER sections. **OER fees averaged \$16 per student across all fee-based sections at the seven colleges.** In the student survey, 14% of students enrolled in OER courses at the grantee colleges reported paying OER fees.

Twelve grantee colleges also reported that students could purchase optional print copies of OER textbooks or course packs containing OER materials. These purchase opportunities were reported for 15% of the certified OER courses offered during the grant period, and **the cost of these printed materials averaged \$33 per OER section.** Thus, even students opting to purchase printed copies of OER materials continued to save at least 50% of the minimum \$65 savings expected from enrolling in an OER course.

The overall net savings to students from the ATD OER Degree Initiative is estimated at \$10.7m or more during the two-and-a-half-year grant period (see Figure 16). This figure takes into account student purchasing behavior and offsets to student savings from OER course fees and printed materials. These incidental OER costs had a modest impact on students, reducing overall student savings by between 5% and 11%.

²² Sales data provided by grantee colleges indicated that new print textbooks (which also includes sales of digital access codes) represented about two-thirds of textbook sales at their college bookstores, while used and rented print textbooks each accounted for approximately 15% of sales. Digital books represented a very small portion of bookstore sales across colleges.

Figure 16. Aggregate Minimum Student Savings in OER Degree Pathway, 2.5 Years (Fall 2016–Fall 2018)



Note: The “maximum” net student savings—under the assumption that all students buy new textbooks from the bookstore—are estimated at \$19.4m - \$20.1m; gross savings (before factoring in the incidental OER costs shown in the graphic) are estimated at \$20.6m.

Source: Institutional cost data, SRI 2017 student survey; rpk GROUP analysis.

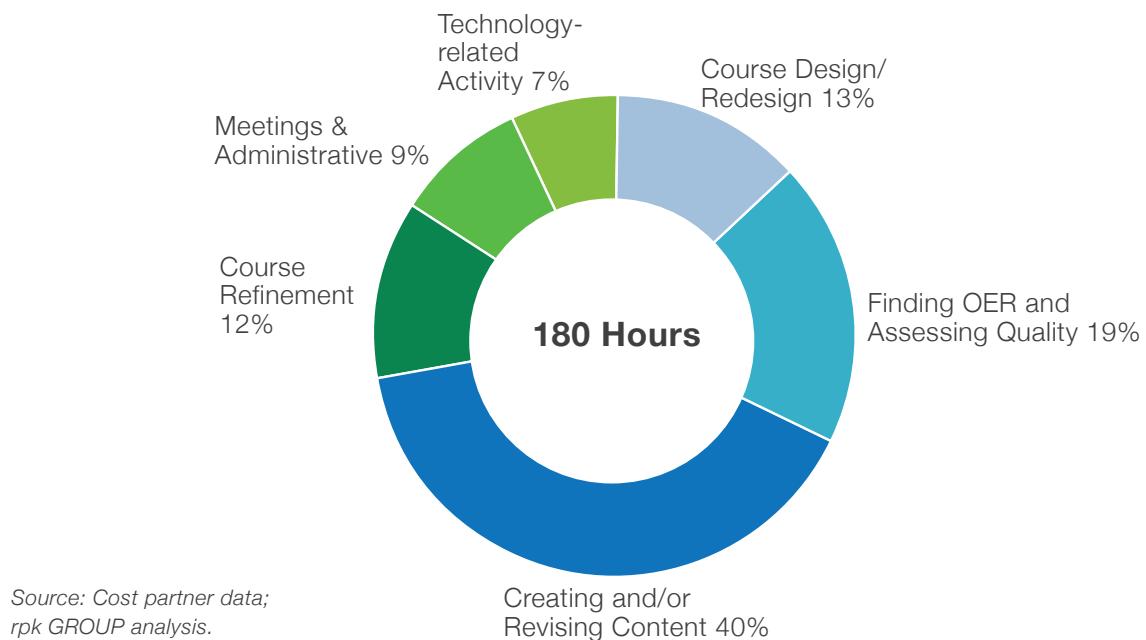
Costs to Develop OER Degree Pathways

The development of OER degree pathways requires investments of both time and financial resources. Colleges often have a narrow view of program start-up costs and only consider the stipends and/or release time commonly provided for course development. However, the largest start-up costs for an OER degree are shown to include the value of faculty and staff time directed toward developing and scaling OER activities. This includes hours devoted to course development as well as time directed towards building the infrastructure that supports OER. This infrastructure can include administrative organization; professional development activities; academic support (e.g., libraries and instructional designers); and technical support to identify OER courses in campus systems, such as those that inform class schedules.

Five cost partners shared detailed information on revenues and expenses associated with developing their OER degree pathways to provide a comprehensive look at the resources required. The five cost partner colleges were asked to report all sources of funding that supported the development of their OER degree pathways and all associated costs, including faculty and staff time, even if not directly supported by ATD grant funds (see Figure 17).

This section examines the costs of starting up and sustaining an OER degree pathway. We focus in particular on OER course development costs, which are a key cost driver. We finally consider the overall program costs, the ways in which OER degrees were funded, as well as the financial impact on bookstore revenues, in order to address the question of sustainability.

Figure 17. Average OER Course Development Hours, by Type of Activity



Startup and Ongoing Costs

Colleges initially invested in OER infrastructure before increasingly shifting their resources to course development. The majority of program costs (87%) were expended across the first two years of the OER Degree Initiative. During the initial startup-up year 2016-17, colleges directed their resources (averaging about \$250,000) equally into the development of OER courses and program infrastructure, including administrative planning; professional development; and engaging librarians and instructional designers to provide instructor support. In year 2, colleges increasingly focused on course development activities, which grew to account for a majority (57%) of spending that year.

The ongoing costs of supporting an OER degree pathway after the grant are difficult to determine during a 2.5-year grant initiative. **Ongoing costs**

are expected to include course revisions, monitoring and reporting on OER activity, and possibly scaling the use of OER materials to other colleagues or departments. Colleges that continue to convert additional OER courses could expect their ongoing costs to be higher than when just maintaining their existing OER activity. Spending patterns from the cost partners show significant declines during the final six months of the grant as grantees completed their course development commitments for the initiative. This pattern suggests ongoing costs will be lower than launching an OER degree pathway (annualizing the final six months of the cost partners' spending translates into \$150,000 per year, on average). On the other hand, most students took fewer than four OER courses in most colleges, suggesting that degree pathways may not have been fully developed.

OER Course Development Costs

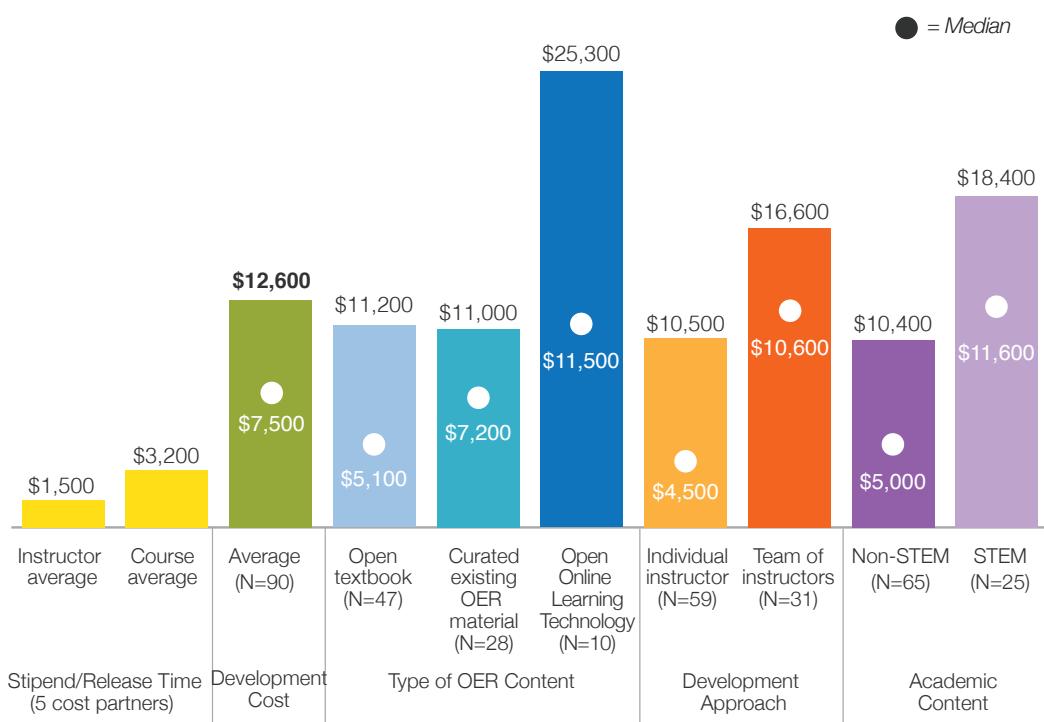
Colleges' largest cost driver in creating OER programs are the expenses associated with developing OER courses. The time and cost of developing OER courses were estimated based on weekly time logs of course development activities that instructors at the five cost partner colleges maintained while they were developing their OER courses. The cost partner colleges aggregated the weekly time logs and submitted them to rpk GROUP every six months; the value of instructors' time was then estimated by applying each college's hourly salary and benefit cost (by academic rank) to the hours reported. This information was also combined with data on student course enrollments to understand the unit costs for each OER course

that was developed and delivered. The development costs presented here include only compensation costs; stipends/release time varied and were reported in total, rather than for specific courses or instructors.

OER courses took about 180 hours on average to develop (see Figure 18). Instructors spent about 60% of course development time finding OER and assessing its quality (19%) and creating or revising content (40%).

The compensation cost of developing OER courses averaged \$12,600 (salary and benefits) at the five cost partner colleges during the grant period (see Figure 18). The costs of instructors' time exceeded the value of stipends/release time the

Figure 18. Compensation Costs of Developing OER Courses



Source: Cost partner data; rpk GROUP analysis.

cost partner colleges provided, which was valued at \$3,200 per course, on average, suggesting these payments are not a good proxy for the full cost of developing OER courses. Stipends/release time for individual instructors averaged \$1,500.

Adopting vs. adapting OER has little impact on development costs, but courses using open interactive learning systems (e.g. MyOpenMath, Lumen's Waymaker) were twice as expensive to develop. More than 80% of courses developed by the cost partner colleges adopted open textbooks (52%) or curated existing OER materials (31%). The average development hours and costs for these courses were nearly equal, averaging about 170 hours and translating into approximately \$11,000 in the value of instructors' time.

Although a small share of courses at the cost partner colleges (11%) utilized open interactive learning systems, their average development costs were twice as high (\$25,300), reflecting about 100 additional hours that instructors invested compared to other types of OER. These digital approaches consumed more hours for both individual and teams and were also more likely to include the conversion of STEM (science, technology, engineering, and math) courses.

STEM courses were more expensive to develop, but partially because of the technology used.

Just over one-quarter of course conversions were in STEM fields. These courses cost \$18,400 in instructor time, compared to \$10,400 for non-STEM course conversions. While STEM courses were equally likely to be developed by individual instructors or design teams, they were more likely to use open

interactive learning systems, which was primarily responsible for the cost differential. However, STEM courses adopting open textbooks were still about 25% more costly to develop, on average, than non-STEM courses.

Introductory 100-level courses were more expensive to develop. These lower-level courses were about a third more expensive to develop than upper level courses (\$13,400 vs. \$10,100). Lower-level courses were more costly in part because about 30% of the courses were in STEM fields. Comparing non-STEM courses only, lower-level courses also cost more (\$11,200 vs. \$8,200), because independently developed lower-level courses used nearly twice as many course development hours as upper-level courses.

The most cost-efficient courses were non-STEM courses created by adapting existing OER materials or adopting open textbooks.

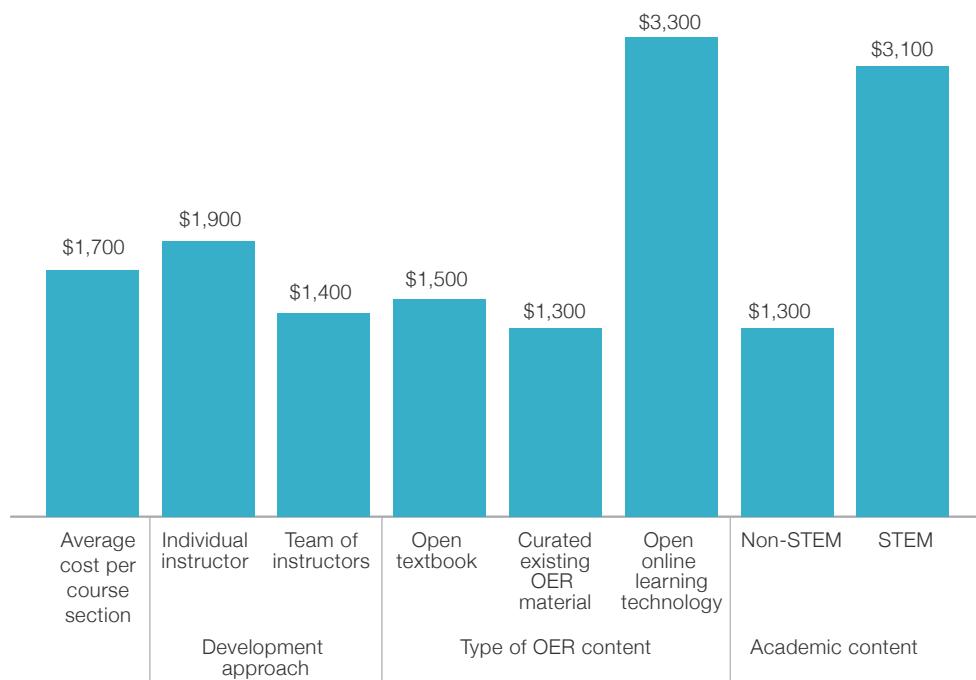
Non-STEM courses using open textbooks or adapted existing OER materials cost an average of \$1,200 per section to deliver during the most recent term in which the courses were offered.²³ Because courses using open textbooks generally had larger class sizes, these courses were the most cost-efficient on a per enrollment basis.

Team-based OER courses cost more to develop but achieved lower per student costs because of increased adoption by instructors.

Courses developed in teams were about 60% more expensive to create than those developed independently (\$16,600 vs. \$10,500) (see Figure 19). Teams spent more time creating and revising content than individual course developers (45% vs.

²³ Unit cost calculations for course development utilize the number of sections and enrollments during the most recent term the course was offered. This approach compensates for the timing of course development across the grant period. Courses developed early in the grant initiative could be offered across more terms than those developed later in the initiative, so limiting calculations to the most recent terms eliminates this factor in comparative analyses.

Figure 19. Unit Cost Variation by Development Approach



Note: Unit costs are calculated using 1) the value of instructors' time spent on course development/revisions, and 2) the number of certified OER sections in the most recent term during which each OER course was offered. The calculations do not include the total number sections offered during the grant periods because 1) courses were launched as they were developed, and 2) they continued to be offered according to the college's regular course offering schedule therefore most courses were not offered throughout the full grant period.

Source: Cost partner data; rpk GROUP analysis.

35%) and spent less time on course design/redesign and refinement, but otherwise their activities were similar. Interviews revealed that teams can require more development hours because of additional coordination, sifting through an abundance of team materials, and time required to review/comment and come to consensus. Teams also can provide advantages in terms of confidence in course quality, a less isolating experience, and faster time to course completion.

While team-based development approaches had initial higher costs, they ultimately led to increased adoption among instructors and a larger number of students enrolled in these courses, reducing their unit development costs. During the most recent term in which an OER course was offered, team-

based courses averaged twice as many sections per term (12 sections vs. 6 sections). The cost per section during the most recent term offered averaged \$1,400 for team-based creation and \$1,900 for individually developed courses (see Figure 20). The cost per student averaged \$55 for teams and \$68 for independently developed courses.

Time spent on course revisions increased development costs. Even after courses are developed, nearly one-half of instructors participating in SRI's survey reported making modifications to their certified OER courses after the first term. Among those reporting changes, 40% made moderate or major modifications, most frequently to add more materials or change how students interacted with the content. The costs of these courses were

substantially higher due to revisions (see Figure 20), but the high cost may also be a function of the types of courses that were revised, as about 40% of these were STEM courses and/or used open interactive learning systems. Comparisons across all courses also show that a larger share of team-based developers reported making revisions. Reducing course revisions could lower average course development costs by as much as \$3,000 (from \$12,600 to \$9,600).

Overall Program Costs and Funding Sources

The full cost of developing an OER degree pathway averaged \$576,000 across the five cost partners during the 2.5-year grant period.

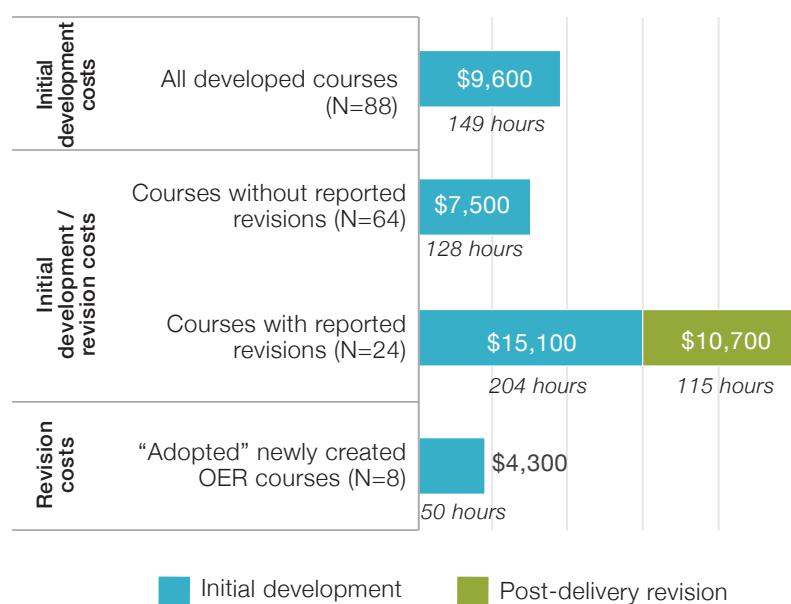
Program costs varied among the cost partners, ranging from approximately \$300,000 to \$1 million. Program expenses are influenced by multiple

factors, including: the number and types of courses developed; the administrative and professional support services provided; college salary and benefit rates; and additional funding sources available to support course development stipends.

College resources funded most of the OER

degree pathway development costs. During the grant initiative (fall 2016–fall 2018), cost partners budgeted an average of \$251,000 to support their OER programs, contributing 43% of costs. (Grants from ATD were \$100,000 per college, except for those in consortia, which shared grants of \$300,000; cost partners received an additional \$30,000 for participating in research activities.) One-half of this *budgeted* funding came from foundation grants from the ATD initiative or other OER-related projects. In addition to the 10% colleges provided in budgeted funding, they also provided more than one-half of the total program funding indirectly—these unbudgeted

Figure 20. OER Course Development and Revision Costs



Source: Cost partner data; rpk GROUP analysis.

resources came from existing college cost centers in the form of faculty and staff time.²⁴

Two-thirds of all cost partner expenditures supported the development of OER courses (see Figure 21). The value of instructors' course development time and the stipends/release time that instructors received accounted for about half of program expenditures. The remaining 14% of course development expenses reflected the value of time that academic support staff (librarians, instructional designers, etc.) devoted to the development of OER courses.

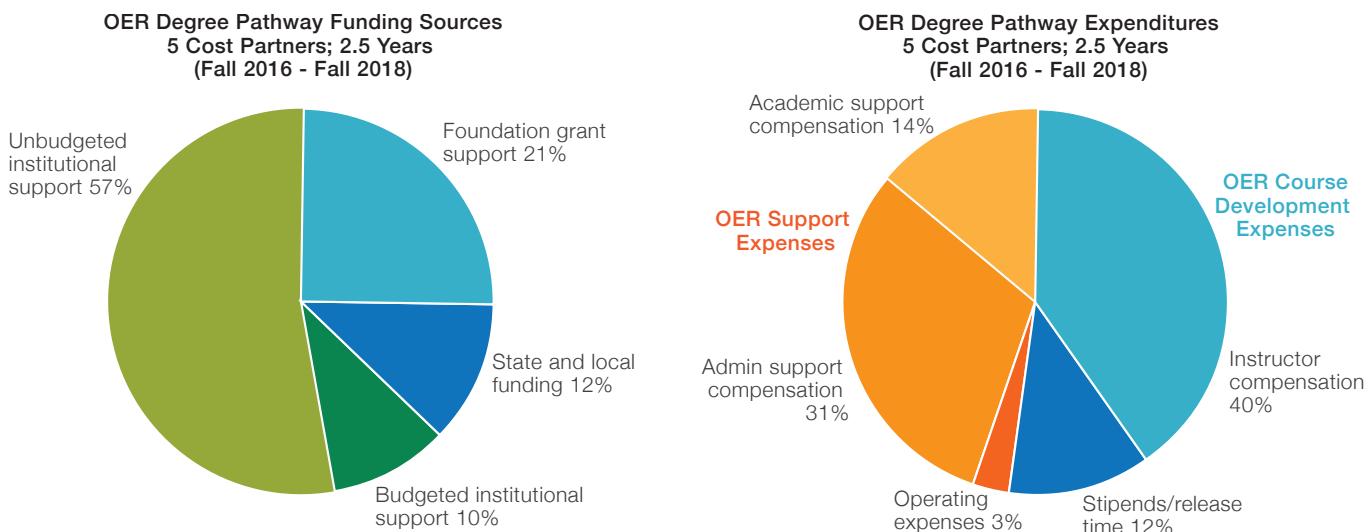
About one-third of program expenditures provided general support for the project.

The majority of infrastructure-related expenditures covered administrative oversight and support (31%) for the program. The cost partner colleges had very few direct operating expenses because they already had access to existing technologies required to develop and deliver OER courses.²⁵

Impact on Bookstore Revenues

The OER Degree Initiative's impact on colleges' bookstore commission or profit is smaller than anticipated on many college campuses, largely because many students already purchase

Figure 21. OER Degree Pathway Revenue and Expenditures



Source: Cost partner data; rpk GROUP analysis.

²⁴ The cost partner colleges also generated an average of \$2.5 million in tuition revenue from enrollment in Lumen Learning-certified OER courses. This revenue is not included as an OER funding source; it supports general instructional costs regardless of whether the courses are taught with OER or traditional instructional materials.

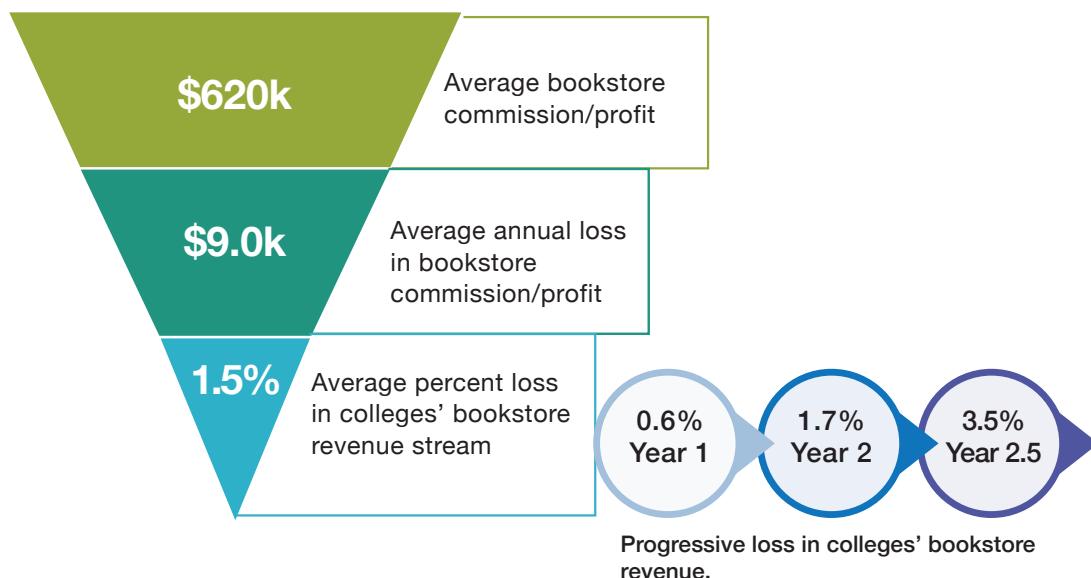
²⁵ Preexisting capacities and data availability were criteria for the grant and for selecting cost partners, so it is possible that the costs reported here might be different from those of more typical colleges.

textbooks elsewhere.²⁶ The financial impact is further reduced because many colleges have partnerships with vendor-operated bookstores and receive only a percentage of total sales -- or may have no impact at all if their sales were already below the minimum annual commission guarantee in their bookstore contracts.

During the 2.5 years of the grant, the annual bookstore commission/profit averaged about

\$620,000 per year across the grantee colleges (see Figure 22), but varied widely among large and small colleges.²⁷ **In total, grantees were estimated to have collectively lost about \$725,000 in bookstore commission or profits during the 2.5 years of the grant -- about \$22,600 on average per institution, or \$9,000 annually, representing 1.5% of their average annual commission or profits.²⁸**

Figure 22. Average Annual Impact of OER on Grantees' Bookstore Revenue, 2.5 Years (Fall, 2016–Fall, 2018)



Source: Institutional cost data; rpk GROUP analysis.

²⁶ Grantees also reported that bookstores typically sold 44% of required textbooks and other course materials adopted by instructors. The variance around the grantees' median bookstore "sell-through" rate ranged from less than 10% to 75%. Student purchasing patterns may contribute to this variance, but data availability is also a potential factor. Some bookstores are connected to campus systems that permit usage of actual course enrollment data to calculate sell-through rates while others utilize data on "maximum" enrollment allowed for each course section.

²⁷ Information provided by grantees on bookstore sales was used to estimate the impact of reduced textbook sales on the colleges' revenue stream. Vendors operated bookstores under contract with 28 of the grantee colleges; five colleges had self-operated auxiliary bookstores. Under contractual bookstore agreements, the colleges received a sales-based commission negotiated as a percentage of store sales which typically included a minimum commission guarantee; self-operated bookstores typically returned some or all of their profit to the college.

²⁸ The bookstore impacts may be conservative because they do not account for students enrolled in other non-ATD OER courses on campus. Excluding these other OER students would increase an institution's average bookstore sales per enrollment (by reducing the denominator), and when applied to OER enrollments would then increase the potential financial impact. However, alternate calculations constructed from estimated student savings suggest the magnitude of the financial estimates impacts presented are reasonable. The alternate estimates yielded average annual losses of \$12,500 or 2% of colleges' average commission/profit; aggregate commission losses were less than \$1.0m and averaged about \$31,200 per college across the grant period.

Grantees' bookstore revenue losses grew each year as their OER programs scaled up but remained comparatively small. **Once all colleges had fully launched their OER degree pathways in summer/fall 2018, the impact of OER courses on colleges' bookstore revenue stream averaged 3.5% of the typical commission/profit.** Growth in OER enrollments, rather than rising prices, were responsible for OER's increased impact on bookstore commissions/profits, which averaged only 1.7% in the previous year.

Another contributing factor to the modest bookstore impacts was the small number of ATD courses and sections in comparison to the colleges' total course offerings. By fall 2018, certified ATD OER courses represented just 2% of the total number of courses offered by grantees' colleges. Grantees broadened access to OER by offering multiple sections of OER courses but had **converted fewer than 4% of the total course sections offered across their campuses during summer/fall 2019, which lessened the impact on bookstore commission revenue/profits.**

Moreover, the overall impact of these bookstore losses on institution budgets is very small since bookstore revenue streams typically contribute less than 1% of total institution revenues. Framing the bookstore financial losses as another "cost" of developing an OER degree pathway, the bookstore losses at the five cost partner colleges amounted to just 5% of their total program expenditures.

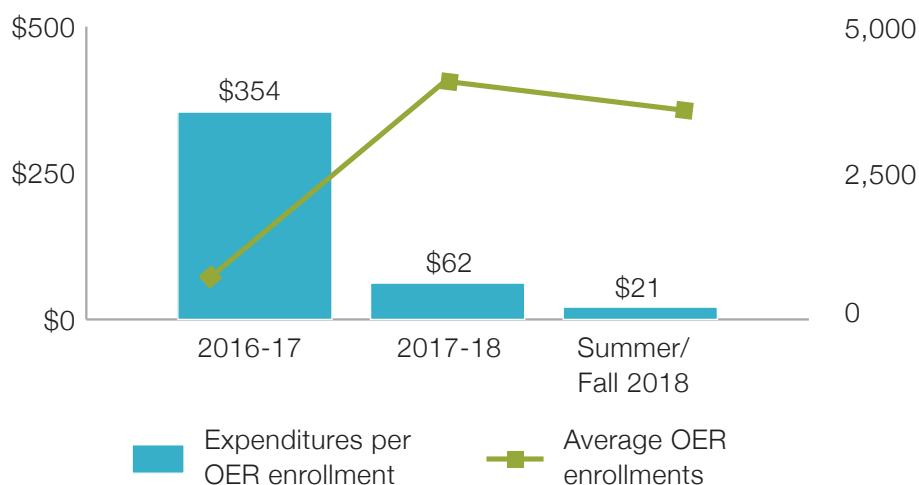
Scaling OER to Reduce Unit Costs

Colleges have opportunities to reduce their ongoing costs while also expanding OER opportunities by introducing new efficiencies and shifting focus to unit costs. Unit costs are measured here as total cost partner expenditures per enrollment in certified pathway OER courses. Shifting from total cost to a unit cost perspective helps colleges better understand what they are getting for the resources they are spending.

Unit costs declined over the grant period as more OER courses were launched and student enrollments grew. Initial start-up costs also tapered off near the end of the initiative, further contributing to lower unit costs. **During the full 2.5-year grant period, unit costs at the cost partner colleges averaged \$70 per enrollment in certified OER courses.** Unit costs averaged about \$350 during the first year of the initiative, when OER enrollments averaged about 700 at the cost partner colleges (see Figure 23). By the final six months of the grant initiative, unit costs declined to \$21 as spending declined and average OER enrollments grew to about 3,500 at the cost partner colleges during summer/fall 2018. If OER enrollments continue to grow, the average unit cost of \$70 per enrollment is expected to decline further after the grant period.

Colleges can adopt policies to drive down unit costs, such as requiring courses to remain OER for a specific number of years and incentivizing departments to convert all sections of a course to OER. For example, the Texas Community College consortium is sharing courses across eight campuses in its system and has limited modification privileges for courses that were converted to OER during the grant initiative. Other colleges, including Bay de Noc Community College and Odessa College, require that OER materials be adopted by all sections of a course that was converted to OER.

Figure 23. Declining Unit Cost of OER Courses



Source: Cost partner data; rpk GROUP analysis.

Cost Effectiveness of OER Degree Pathways

The impact of OER course taking can generate a financial return on investment for colleges by enabling students to attempt and earn more course credits, generating additional tuition revenue. Following a similar approach as the academic outcomes studies, we examined the relationship between OER course taking and the number of credit hours students attempted in comparison to similar students that did not enroll in any OER courses. These analyses were conducted for the five cost partner colleges, which are a subset of the 11 research partners for which academic impacts were previously presented, allowing us to look more closely at the financial impact of this result. The impact analysis for credits attempted followed the same methodology as presented for student GPA and credits completed (see methodology, Appendix D).

At three of the five cost partner colleges, OER course taking had a significantly positive association with the number of credits students attempted. **Students enrolling in one or two OER courses at those colleges attempted an average of 2.1 to 4.7 additional credits more than similar students who did not enroll in any OER courses.** At one of those colleges we could also examine the additional credits attempted by students with a “high dosage” of three or more OER courses; those students attempted 5.4 additional credit hours. Two of the cost partner colleges had results that were not statistically significant (see Appendix E, Table E2). We were able to control for student retention at two of the three sites with positive outcomes, and one of the two sites where no association was shown.

These positive results for students also have a positive financial impact for colleges. As students attempt more credits, additional tuition and fee revenues are generated at the three colleges showing additional credits attempted. The five cost partner

colleges invested an average of \$576,000 to develop their OER programs (see Table 11). As a result of that investment, the increased credits attempted by students was estimated to generate an average of \$1.1 million in gross revenue, suggesting that, on average, the OER programs covered their initial investment costs.

However, there is also an additional cost to teach those OER students that are attempting additional credit hours. After combining these additional instructional delivery costs with the OER program development costs, **the net financial benefit estimates averaged \$38,000 across the five cost partner colleges. On average, the cost partners exceeded the breakeven point on their investment, with gross revenues estimated to return \$1.03 for every dollar spent (total program and delivery costs), which represents a 3% average return on investment.**

The net financial impact varied widely across the cost partner colleges, with three colleges generating new revenue. Our analyses showed no financial impact at 2 of the 5 cost partner colleges. The other three colleges all generated revenue that covered their OER program costs. After considering the additional instructional delivery costs associated with increased course taking, there was positive net revenue estimated at two colleges ranging from about \$450,000 to \$520,000, generating a return on investment (ROI) of 30% to 45%. At the third college gross revenues nearly equaled its total program and delivery costs. The differentiating factors in the size of each college's net financial gain included both the OER program development costs at the individual colleges and the size of the impact on credits attempted.

Colleges' return on investment could potentially exceed the ROI shown if students who took OER courses were

Table 11. Financial Return on Investment (ROI) from Credits Attempted 2.5 Years (Fall 2016–Fall 2018)

Cost Partner Colleges (N = 5)	Aggregate	College Average	Average per OER Enrollment
Program Costs	\$2.9m	\$576k	\$70
ROI from Additional Credits Attempted ^{a, b}			
Gross revenues	\$5.6m	\$1,115k	\$136
Total costs	\$5.4m	\$1,077k	\$131
Net financial impact	\$188k	\$38k	\$5
ROI (%)		3%	
ROI (\$)		\$1.03	

^a ROI calculations include all five cost partner colleges, including two colleges that had no demonstrated impact on credit hours attempted.

^b Gross revenue includes additional tuition and fee revenue from an increase in credits attempted. Total costs include OER program costs and the instructional expenses associated with an increase in credit hours attempted. The net financial impact equals gross revenues minus total costs. ROI is the net financial impact divided by total costs, or alternately, gross revenues divided by total costs.

Sources: Cost partner data, SRI student impact analysis; rpk GROUP analysis.

more likely to reenroll the following term, generating additional tuition revenue. The colleges in our study are all public colleges and most state funding formula are based, in part, on student enrollment levels, so rising enrollment also generates additional public funding. However, we were unable to analyze retention across the sites because of limitations in the data and the dosage treatment approach; the roll out of OER courses was also slower than expected so many sites had insufficient samples of students who took multiple OER courses early in the study period.

The **balance of the evidence suggests that OER enrollment was positively associated with student course taking, but not all colleges benefited equally.** When OER did have a significant effect on student course taking, the positive financial revenue it created covered colleges' investments in their OER programs and more, as OER courses continued to generate positive net revenue even after accounting for additional instructional costs.

Key Questions for Colleges to Consider around OER and ROI

1. What strategies and policies could reduce OER program costs?
2. Should colleges begin OER development with less costly non-STEM courses?
3. Is the higher cost of team-based development worth having OER developed in a team setting?
4. What guidelines or policies might colleges implement around the iteration of OER courses to reduce revision-related costs?
5. How might colleges communicate the academic and financial benefits of OER?



Summary and Implications for Future Directions

This report looks for the first time at the academic and economic outcomes of a large-scale initiative that promoted development and rollout of OER degrees. It presents new data and analyses regarding the scaling of OER course offerings and enrollments, instructor experiences, academic outcomes associated with OER course taking, and financial impacts on students and institutions. Research on student experiences and the implementation of OER degrees is shared in detail in the two interim reports. We highlight some findings from those reports here to place new research in context and inform future directions.

A central objective of the OER Degree Initiative was to catalyze development of OER courses at scale within—as well as across—stitutions. The dramatic growth in instructor participation, course offerings, and student enrollments at most grantee institutions indicates that the initiative succeeded in this goal. Generally positive experiences and perspectives of instructors suggest that this model can be feasible and rewarding when they receive learning opportunities and supports for OER course development. Instructors increasingly reported that use of OER prompted changes in pedagogy, suggesting that the OER programs can influence the quality of instruction as well as affordability. The initiative also demonstrated that collaborative course development efforts can pay off over time, potentially enhancing institutional culture.

Students reported that instructional material costs typically pose a significant burden. While only a small share said they had withdrawn from college or courses (prior to taking the survey) due to textbook

affordability, over half had refrained from purchasing required materials for at least one course, usually due to cost. Approximately 40% of students reported that OER courses would increase their ability to afford college. Low-income and underrepresented minority students are disproportionately impacted by textbook costs, implying that textbook cost reduction would support equity goals at these institutions. Moreover, in focus groups students expressed appreciation for the quality of OER courses, in particular that the materials were better aligned with instructional goals and were generally more relevant, accessible, and manageable. They especially valued having online access to course materials.

In most research partner colleges, students who enrolled in OER courses earned significantly more credits with roughly the same cumulative GPA. Student savings averaged \$65 or more per OER course, and all students had access to course materials from day one. Only 1 out of 11 colleges showed evidence that students taking OER courses fared worse academically. Limitations of our study design mean we cannot determine whether OER course taking caused increased credit accumulation in a majority of research partner institutions, or to what extent cost savings, access, or improved course quality were factors. Still, these findings are encouraging and warrant further application and study.

These benefits for students are not free. Most instructors reported spending 1½-2 times as much time developing OER courses compared to traditional courses, primarily locating, vetting, and adapting content. Stipends paid to instructors only covered

a small share of this additional time; we cannot say whether the remaining time was diverted from other work activities or from instructors' personal time. Cost partner institutions invested on average \$576,000 developing OER degrees, and of this less than one fifth was covered by grant funds. From the college perspective, this investment appears to have paid off, as unit costs of offering OER courses declined over time among the five cost partners. Thus, while the average unit cost of the OER program was \$70, the unit cost declined to \$21 by the end of the grant period as enrollments increased.

The OER Degree Initiative also provided opportunities for learning about implementation of an OER program at the institution level. Following are some observations about the rollout of OER degrees and opportunities for future development:

- **Connect OER degrees with strategic goals and provide high level administrative support.**

Senior administrative support was important to build momentum, recruit faculty, and clear obstacles. In most cases administrators were able to articulate connections between the OER Degree Initiative and broader strategic goals, such as equity, access, and affordability. In practice, however, these connections were sometimes enacted at a superficial level. For example, at one college the initiative was expected to fit with guided pathways initiatives that were underway at the same time, but there was little coordination in the implementation of the two initiatives. Future initiatives can take additional steps to operationalize connections between OER programs and other strategic initiatives.

- **Ensure faculty receive learning opportunities and supports.**

Given the up-front time required to develop OER courses and many demands on instructors' time, it is likely unrealistic to expect this model to scale up through individual volunteer efforts. Instructors who were satisfied with the training and supports provided for OER conversion were more likely to make changes to pedagogy, to have positive views about OER, and to recommend OER to their colleagues. Supporting team development efforts and converting whole courses can reduce instructor burden and offer a more sustainable model than individual, single section conversions.

- **Address logistical and cultural barriers to course sharing.**

Another goal of the OER Degree Initiative was to increase the supply of high-quality OER courses and thus reduce obstacles to scaling. Our sense is that progress on this front was slower than expected. We observed a few instances of instructors sharing OER courses but also heard of many concerns ranging from logistics to intellectual property. Future initiatives might explore further what infrastructure and incentives would be needed to facilitate sharing of entire OER courses (not just OER materials) across colleges.

- **Support use of efficient course development practices.**

With course development costs making up the primary expense for OER degree pathways, strategies to reduce those costs will have a direct impact on overall OER program expenditures. Identifying OER materials, academic supports, and best practices that reduce time spent finding and revising OER materials can lessen OER course development

costs. Practices and policies to increase efficiencies and scale OER courses will also reduce the cost per OER student.

- **Communicate OER options strategically to students.**

Data collections in fall 2017 and spring 2018 revealed low student awareness of OER course options and degrees. Many colleges were relying on communication channels that proved ineffective at reaching students for this purpose, such as the college website. Given the common strategic objectives of OER initiatives to advance equity, affordability and access goals, colleges should develop strategies to target communications about OER options to students they most wish to reach.

In general, the concept of an OER degree pathway was useful in setting a point on the horizon around which instructors and staff could galvanize activity. The premise of enabling students to obtain a degree without paying a single dollar for instructional materials is compelling and easy to understand and communicate. So too is the argument that cumulative exposure to courses redesigned with OER is more likely to change students' academic trajectories than simply taking one-off OER courses. Finally, the concept of an OER degree pathway sends a clear signal that cross-unit coordination is needed across academic departments, advising, the registrar, IT, instructional design, the library, and the bookstore. Elevating OER into a pathway raises the likelihood of a coherent student experience supported by a coordinated and sustainable set of activities.

We observed signs that part of this vision – the benefits of implementing OER at scale within an institution – were realized in many cases. The number of OER sections available to students and

the population of instructors involved in OER and having a positive experience expanded dramatically. By the end of the initiative some critical pieces, such as adding OER tags to course catalogues, were falling into place. At some colleges, awareness and enthusiasm about the OER initiative was reportedly very high.

On the other hand, we did not see evidence that colleges truly implemented degree "pathways," perhaps because the grant period was not long enough. The vast majority of students who were affected by the initiative took fewer than four OER courses. Few of the campuses made it easy for students to enroll in a sequence of OER courses in their major. As a result, it was not feasible to evaluate the impact of OER pathways on student achievement, as originally intended.

Looking ahead, colleges should consider whether OER programs might best be organized around degree pathways or some other objective, such as maximizing impact in large enrollment courses. Those that are committed to degree pathways should explore ways to ensure that students can actually experience these courses as pathways, for example through mechanisms such as block scheduling and advising.

This research provides clear evidence of experiential and economic benefits for students and promising evidence of academic benefits from taking multiple OER courses. It also supports continued institutional efforts to support OER at scale. Future research can build upon these findings by examining the different ways in which the affordances of OER may empower faculty to adopt new pedagogical strategies and the impacts of innovations in teaching on student course outcomes.

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Appendix A. OER Section Offerings by Institution

Institution	Summer/Fall 2016	Winter/Spring 2017	Summer/Fall 2017	Winter/Spring 2018	Summer/Fall 2018
Consortium A College 1	55	68	29	23	216
Consortium A College 2		35	48	45	98
Consortium A College 3		11	93	91	121
Consortium A College 4		21	86	132	N/A
College B	33	45	82	68	85
College C	25	30	72	45	206
College D		18	45	62	97
Consortium E College 1		4	31	22	67
Consortium E College 2		3	21	25	36
Consortium E College 3		6	34	0	47
Consortium F		2	6	13	13
College G		3	78	78	235
College H	10	39	100	78	120
College I	28	32	40	38	62
College J		2	11	17	18
College K		19	128	116	169
College L		97	213	160	235
College M			25	110	187
College N		11	98	84	260
College O	14	32	77	124	156
Consortium P College 1		2	6	6	23
Consortium P College 2	11	5	49	49	79
Consortium P College 3			4	12	8
Consortium P College 4			6	29	16
Consortium Q College 1	1	5	52	63	82
Consortium Q College 2		9	29	38	57
Consortium Q College 3			17	12	43
Consortium Q College 4					19
College R		14	43	58	73
Grand Total	177	513	1,523	1,598	2,828

Appendix B. OER Enrollment by Institution

Institution	Summer/Fall 2016				Winter/Spring 2017				Summer/Fall 2017			
	Starting enrollment	Completion	Pell starting enrollment	Pell completion	Starting enrollment	Completion	Pell starting enrollment	Pell Completion	Starting enrollment	Starting enrollment	Pell completion	Completion
Consortium A College 1	1411	1032	642	446	1671	1303	841	655	736	620	270	226
Consortium A College 2					914	649	265	188	1324	935	437	309
Consortium A College 3					303	213	158	133	2257	1838	1219	1085
Consortium A College 4					515	402	148	120	2097	1587	520	389
College B	527	468	173	144	715	578	308	224	1410	1161	533	399
College C	771	502	448	268	851	543	476	277	2133	1458	1073	659
College D					378	255	210	142	944	723	578	414
Consortium E College 1					81	70	62	53	852	638	616	461
Consortium E College 2					56	40	65	39	442	13		
Consortium E College 3					187	124	153	100	891	610	823	525
Consortium F					59	48	28	23	170	141	50	42
College G					81	55	34	25	1243	900	761	547
College H	212	132	78	45	722	528	286	239	2149	1487	727	467
College I	657	315	360	171	784	372	589	278	993	556	569	288
College J					37	36	14	13	222	191	78	71
College K					414	302	140	99	3054	2309	1296	970
College L					2261	1749	802	562	4912	3875	1266	958
College M									650	418	188	113
College N					275	148	80	48	1951	1212	824	499
College O	586	359	137	90	1178	848	348	267	3067	2038	912	642
Consortium P College 1					135	89	80	52	94	69	50	35
Consortium P College 2	309	113	210	67	109	33	85	24	1423	888	914	548
Consortium P College 3									290	201	138	95
Consortium P College 4									134	88	65	41
Consortium Q College 1	38	17	11	5	81	48	36	23	959	703	418	266
Consortium Q College 2					184	140	42	27	660	460	198	128
Consortium Q College 3									331	242	129	94
Consortium Q College 4												
College R					531	371	253	177	1587	1102	684	499
Grand Total	4,511	2,938	2,059	1,236	12,522	8,944	5,503	3,788	36,975	26,463	15,336	10,769

Appendix B. OER Enrollment by Institution (Continued)

Institution	Winter/Spring 2018				Summer/Fall 2018			
	Starting enrollment	Completion	Pell starting enrollment	Pell completion	Starting enrollment	Completion	Pell starting enrollment	Pell completion
Consortium A College 1	658	541	269	217	5334	4277	228	193
Consortium A College 2	1203	889	54	38	2561	2045	538	429
Consortium A College 3	2118	1648	1188	988	2650	2158	1333	1147
Consortium A College 4	3081	2259	845	628	N/A	N/A	N/A	N/A
College B	1181	964	389	288	1456	1149	439	326
College C	1210	959	720	490	6065	4339	3216	2144
College D	1217	855	799	537	2075	1455	1245	858
Consortium E College 1	618	502	447	363	1735	1236	1334	950
Consortium E College 2	459	240	359	168	826	491	463	344
Consortium E College 3					1192	844	1099	694
Consortium F	375	284	91	85	331	267	93	83
College G	1649	1272	814	600	5219	4152	2015	1515
College H	1655	1056	602	360	2818	1935	952	601
College I	886	363	620	254	1451	801	801	430
College J	330	294	122	109	357	320	132	118
College K	2805	2161	984	745	4079	3050	2167	1578
College L	3802	2856	1484	1034	4758	3505	1120	818
College M	2696	732	782	222	4573	3575	1055	800
College N	1764	1090	875	526	5721	3824	2366	1576
College O	4128	2869	1326	974	5625	3863	1255	922
Consortium P College 1	57	46	31	22	291	204	152	100
Consortium P College 2	1299	814	794	460	1864	1285	1132	679
Consortium P College 3	231	152	126	138	184	119	56	38
Consortium P College 4	581	344	308	164	300	218	143	98
Consortium Q College 1	1090	855	454	303	1532	1144	660	434
Consortium Q College 2	829	599	291	201	1330	978	438	304
Consortium Q College 3	222	173	83	66	918	705	349	268
Consortium Q College 4					385	292	108	82
College R	1934	1291	978	686	2276	1574	1167	828
Grand Total	38,078	26,108	15,836	10,666	67,906	49,805	26,056	18,357

Appendix C. Instructors by Institution

Institution	Summer/Fall 2016	Winter/Spring 2017	Summer/Fall 2017	Winter/Spring 2018	Summer/Fall 2018
Consortium A College 1	19	28	10	7	64
Consortium A College 2	0	17	31	28	55
Consortium A College 3	0	9	35	40	33
Consortium A College 4	0	16	37	57	N/A
College B	15	27	39	33	39
College C	12	14	15	24	61
College D	0	7	26	30	43
Consortium E College 1	0	3	21	11	32
Consortium E College 2	0	3	15	16	23
Consortium E College 3	0	4	25	0*	28
Consortium F	0	1	5	8	4
College G	0	2	49	52	109
College H	6	23	49	42	49
College I	18	21	26	25	39
College J	0	2	5	5	9
College K	0	10	79	69	90
College L	0	0	53	51	75
College M	0	0	9	35	99
College N	0	9	46	47	118
College O	7	18	51	58	77
Consortium P College 1	0	2	4	4	12
Consortium P College 2	3	2	27	26	33
Consortium P College 3	0	0	4	7	4
Consortium P College 4	0	0	5	18	10
Consortium Q College 1	1	4	20	26	33
Consortium Q College 2	0	5	19	24	29
Consortium Q College 3	0	0	4	5	12
Consortium Q College 4	0	0	0	0	9
College R	0	10	21	32	33
Grand Total	81	237	730	780	1,222

*Section data submitted by CUNY Hostos indicated that several OER courses were delivered but we were unable to confirm that these had received Lumen certification.

Appendix D: Academic Impact Methodology

Study Design & Sample Identification

We conducted a series of quasi-experimental impact studies to examine the extent to which community college enrollment in OER courses was associated with improved student outcomes, as measured by college credits attained and cumulative college GPA. We analyzed datasets from each of 11 partner community colleges separately given the differing student populations, institutional contexts, study designs, and implementations of OER course pathways.

Each impact study was designed as either a *historical* design or a *concurrent* design. Impact studies employing historical designs identified treatment students and control students based on their initial enrollment during two different time windows. Additionally, treatment-eligible students were required to enroll in at least one OER course during the corresponding time window to be considered treatment students. Similarly, control-eligible students were required to never enroll in an OER course in any enrollment term to be considered control students.

For example, the impact study for Central Virginia Community College (CVCC) employed a historical design. Treatment-eligible students were those who first enrolled in CVCC during fall 2016, spring 2017, or fall 2017. Then, from these students we identified those who enrolled in at least one OER course during these three terms. These students were considered to be treatment students for our analysis. Similarly, control-eligible students were those who first enrolled in CVCC during fall 2014, spring 2015, or fall 2015. Then, from these students we identified those who never enrolled in an OER course during any enrollment term within the available data. These students were considered to be control students for our analysis.

Impact studies employing concurrent designs identified treatment students and control students based on whether students enrolled in OER courses during the same time window. For example, the impact study for Santa Ana College (SAC) employed a concurrent design. We identified all students who were enrolled in SAC during fall 2016, spring 2017, and fall 2017. Then, we identified which of these students were enrolled in at least one OER course. These students were considered to be treatment students for our analysis. The remaining students (those who did not enroll in any OER courses) were considered to be control students for our analysis.

Defining the Treatment Condition

The original design for this study defined the treatment as students enrolling in at least four OER courses during the applicable time window for an impact study. Due to implementation challenges across the initiative, community colleges did not roll out pathways of OER courses as expected with respect to both (a) the schedule of rollout and (b) the marketing and provision of sequences of pathway courses to students. Accordingly, students tended to enroll in OER courses on an ad hoc basis and few students enrolled in four or more OER courses during the course of this study.

Given these implementation challenges, we defined three levels of treatment for the purpose of conducting impact analyses. We considered treatment students to have received a “high dosage” of OER courses if they enrolled in at least three OER courses. We considered treatment students to have received a “low dosage” of OER courses if they enrolled in either one or two OER courses. We

considered control students to have received “no dosage” of OER courses, which is the definition of our control condition. For the purpose of conducting the impact analyses, SRI did not require the OER course be Lumen-certified.

We chose to employ a categorical approach for modeling treatment (high dosage and low dosage) for this study given our theory of action. Our theory of action suggests that students may need to enroll in a sufficient number of OER courses to experience significant impacts to program-level student outcomes. Accordingly, a continuous treatment approach (e.g., using the number of OER courses a student enrolled in as a continuous variable) might not be appropriate.

We conducted model specification checks for all impact analyses using a continuous treatment approach. The main findings and interpretations were consistent across the categorical treatment models vs. continuous treatment models.

Data Screening & Data Cleaning

SRI conducted initial data screening of all datasets received by our research partners to ensure they were eligible for impact analysis. Our initial screening criteria for conducting an impact analysis were: (a) datasets contained enrollment data sufficient to identify treatment and control students; (b) datasets contained one or more outcomes of interest (or sufficient data for us to construct an outcome ourselves); (c) datasets contained sufficient linking data to allow for enrollments to be aggregated to the student level. Additionally, we cross-checked all datasets with our site-specific study implementation plans to confirm the datasets contained the appropriate student populations, enrollment terms, courses, and programs of study. We worked with research partners to clarify any issues regarding missing data, data linking, and data coding.

Next, we performed multiple data cleaning steps to prepare the data for analysis. The data cleaning steps were: (a) removing duplicate enrollment records; (b) screening out students younger than 16 years old; (c) screening out treatment-eligible students with zero OER courses for nonconcurrent analyses; (d) screening out control-eligible students with one or more OER courses for nonconcurrent analyses; (e) site-specific cleaning practices; (f) missing prior achievement data; and (g) missing outcome data.

During the data cleaning process, we applied consistent rules for variable coding to standardize variables across datasets. For example, different partners reported different data regarding students' Pell status. Some partners reported Pell receiving whereas some reported Pell eligibility, and some reported a single datapoint for each student whereas other partners reported term-specific Pell information. We coded students as “Yes” for Pell status if institutions recorded them as being either Pell-receiving or Pell-eligible for any enrollment term during the applicable eligibility window given the study design.

“Site-specific cleaning practices” encompasses a variety of different cleaning practices specific to each research partner. For example, for several research partners we removed students who were dual enrolled in both high school and community college as the literature suggests dual-enrolled students have different enrollment and performance patterns from students exclusively enrolled in community college. We removed these students from the impact analysis to support the results of this impact

analysis being comparable to the other impact analyses. However, we did not have this information available to us for all research partners, so not all datasets were cleaned in this manner.

Baseline Checks & Propensity Score Matching

We conducted baseline difference checks for all cleaned datasets prior to analysis in accordance with What Works Clearinghouse v4.0 Group Design Standards.¹ We checked the baseline differences for students' prior achievement and demographic variables. We considered our treatment and control analytic samples to be non-equivalent if the effect size of any baseline difference was greater than 0.25. For continuous variables we calculated Hedges' g as the effect size, and for categorical variables we calculated Cohen's d as the effect size.

We conducted propensity score matching (PSM) for impact analyses when the treatment and control samples were assessed as being non-equivalent based on our baseline difference checks. PSM is a statistical matching technique that creates artificially similar analytic samples in an attempt to reduce possible statistical bias from observed variables. We employed nearest neighbor matching and allowed treatment students to match with multiple control students, and we allowed for replacement (i.e., different treatment students could match with the same control students). We calculated PSM weights to account for the number of times a given control student was matched with treatment students. We applied PSM weights to all subsequent baseline checks and impact analyses.

After the matching procedure was completed, we again conducted baseline checks on the matched samples. If statistical equivalence was not achieved, we conducted another round of PSM. If statistical baseline was achieved, we proceeded with our impact analysis.

Impact Analysis

We used ordinary least squares linear regression (OLS) for conducting our impact analyses. For samples obtained through PSM, we applied PSM weights to all impact analyses. We included students' prior achievement, demographic variables, and transcript variables as statistical controls in our models. We conducted separate analyses for "low dosage" treatment students and "high dosage" treatment students when research partners reported significant numbers of both treatment groups. We report treatment effect sizes as Hedges' g when treatment effects are statistically significant.

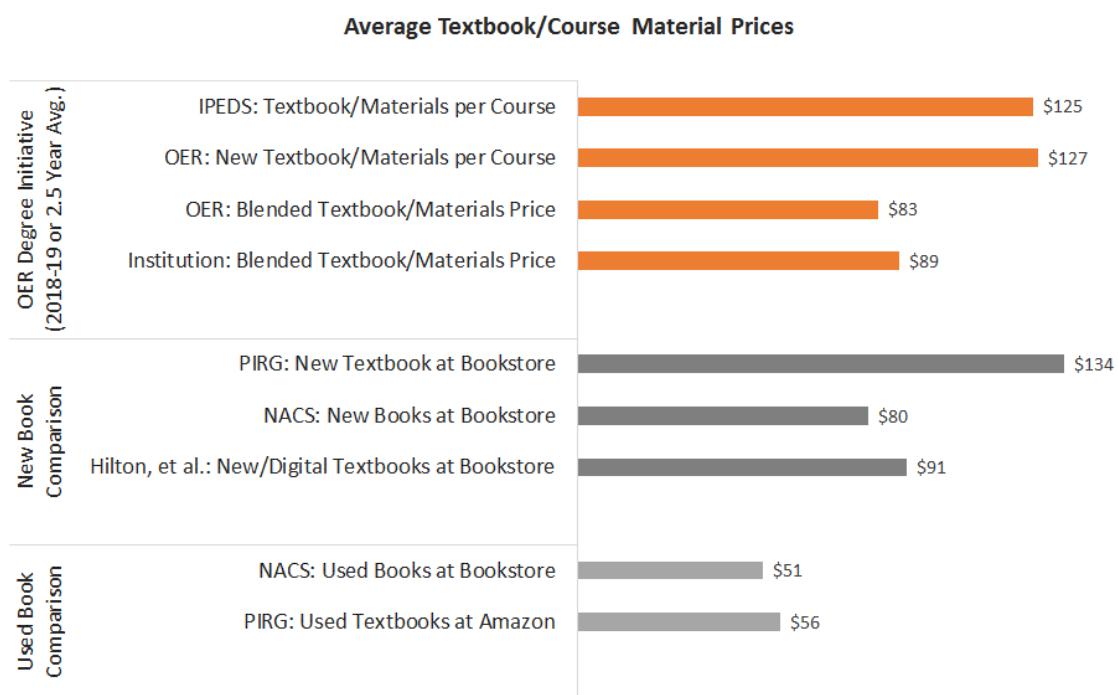
We additionally conducted subgroup analyses for low-income students (i.e., students coded as "Yes" on Pell status) and for underrepresented minority students (i.e., students racially/ethnically identifying as African American/Black, American Indian/Alaska Native, Hispanic, Pacific Islander/Hawaiian Native, Two or more races/ethnicities, or Other) as our theory of action and student survey results suggests there is a possibility that historically underserved students may experience a greater benefit from OER courses than the overall student body. We conducted our subgroup analyses using interaction effects (for example, interacting Treatment with Pell status) to assess whether the enrolling in OER courses had different impacts on low-income students and under-represented minority students.

¹ See <https://ies.ed.gov/ncee/wwc/>

Appendix E: Economic Impact Methodology

Textbook prices. Information about the textbook pricing estimates used in analyses of the cost savings per student are shown in Figure E-1, along with additional comparative information. The colored bars in Figure E-1 represent different types of textbook prices calculated from data the grantees provided. The *Integrated Postsecondary Education Data System* (IPEDS) price includes the annual cost of books and supplies reported to IPEDS (with an adjustment to exclude supplies) on a per-course basis. The OER new textbook price reflects the average price of new textbooks/materials for traditional sections of Lumen Learning-certified OER courses. The two blended textbook prices reflect student purchasing patterns and include new, used, rental, and digital purchases; they are based on actual bookstore sales divided by units sold, both for the institution overall and for traditional sections of Lumen-certified OER courses.

Figure E-1. Average Prices of OER Textbooks Relative to Traditional New and Used Books



Sources: Institutional Cost Data; rpk GROUP Analysis. Hilton III, John Levi, T. Jared Robinson, David Wiley, and J. Dale Ackerman. 2014. "Cost-savings Achieved in Two Semesters Through the Adoption of Open Educational Resources." *The International Review of Research in Open and Distributed Learning*. Vol. 15 No. 2 (April). National Association of College Stores(NACS). 2018. *Independent College Stores Financial Survey 2015-16*. <https://www.nacs.org/research/HigherEdRetailMarketFactsFigures.aspx> (downloaded February 5, 2018).

Vitez, Kaitlyn. 2018. *Open 101: An Action Plan for Affordable Textbooks*. Washington, DC: The Student PIRGS (January). www.studentpirgs.org/textbooks.

The gray bars show comparative prices from the literature. The acronyms reference the three studies listed in the source section at the bottom. PIRG is the Public Interest Research Group, which conducts research on issues of importance for the public. NACS is the National Association of College Stores.

Student savings. Students savings are estimated at the college level using institution-reported data on enrollments, textbook prices and sales, other incidental OER-related costs, as well as information from the SRI student survey and industry-data on textbook costs shown in Figure E-1. Savings estimates were calculated for individual colleges before summing to aggregate grantee totals for each data reporting

period (summer/fall 2016; winter/spring 2017; summer/fall 2017; winter/spring 2018 and summer/fall 2018), and the full 2.5-year grant period shown in Table E1.

Table E1. Student Savings Estimates for OER Degree Initiative Students 2.5-Year Total (Fall 2016–Fall 2018)

Savings estimates reflect enrollment in Lumen-certified ATD Degree Pathway courses only		
	Minimum Savings	Maximum Savings
Student textbook/course materials savings	\$12.0m	\$20.6m
Incidental OER costs (offsets to savings)		
OER fees	\$355k - \$540k	\$355k - \$540k
OER printed texts/course packs for purchase	\$193k - \$739k	\$193k - \$739k
Net savings to students	\$10.7m - \$11.4m	\$19.4m - \$20.1m
Average savings per OER student enrollment	\$65-\$69	\$117 - \$121
Average savings per OER section	\$1,600 - \$1,700	\$2,800 - \$2,900
Average savings per institution	\$334k - \$358k	\$605k - \$628k

*Minimum savings: Some OER students purchase new/used/rental/digital texts from college bookstores; some purchase used textbooks online; some students do not purchase textbooks.
Maximum savings: All OER students purchase new textbooks from college bookstore.
Source: Institutional Cost Data; rpk GROUP Analysis.*

Prior to calculating total student savings, textbook prices were imputed for colleges with missing data. College prices from a prior reporting period were applied when available; otherwise, the grantee average for the reporting period was used.

Maximum student savings were estimated by multiplying colleges' OER enrollment by the average new textbook price (e.g., for traditional sections of courses with a Lumen-certified OER courses).

Minimum savings estimates incorporate student purchasing patterns. Savings estimates were calculated using the colleges' blended textbook prices (new/used/rental/digital), and then adjusted to exclude the proportion of students that purchase books elsewhere or not at all. Savings from non-campus bookstore purchases reflect online purchases of used textbooks at a 58% price reduction compared to new textbooks.² Total textbook savings are the sum campus and non-campus purchases.

Student savings were adjusted to account for incidental OER costs. The range of OER incidental costs shown in Table E1 were calculated from institution-reported data and findings from SRI's student survey, including: the proportion of students reporting they paid OER fees and the average amount paid; the proportion that purchased printed OER materials and the average cost of those materials. The total student textbook/course materials savings less incidental OER costs results in the net savings to students.

² Vitez, Kaitlyn. 2018. *Open 101: An Action Plan for Affordable Textbooks*. Washington, DC: The Student PIRGS (January). www.studentpirgs.org/textbooks

Bookstore revenue impacts. OER's impact on bookstore revenue are based on institution-reported data on total and OER enrollments, campus bookstore textbook/course material sales, the campus bookstore commission rate structure, and the minimum revenue guarantee outlined in each college's campus bookstore contract. If the bookstore commission rate was not provided by the college, the average grantee rate was applied. For self-operated bookstores, a profit percentage was applied instead of the commission rate ((gross sales revenue – total operating expenses) / gross sales revenue).

For each of the five data reporting periods, textbook sales per enrollments were calculated for each college (total college enrollments were adjusted to exclude OER course enrollments). When bookstore data was unavailable for a particular reporting period, the sales per enrollment from a prior or comparable term was applied. When no bookstore data was reported, the average grantee rate was applied.

The number of Lumen-certified OER course enrollments were multiplied by the sales per enrollment to estimate the total sales losses at the campus bookstore. These sales losses reflect the various types of course materials students purchase (new, used, rental, digital) but are limited to campus bookstore sales, so are lower than total student savings.

The financial losses at colleges with vendor-operated bookstores are limited to the commission colleges receive from the vendor, as specified in their bookstore contract. The colleges' commission revenue losses were estimated after considering 1) whether the sales threshold for the minimum annual revenue guarantee specified in the bookstore contract would have been met if the sales losses had not occurred, and 2) the commission percentage rate that would have applied (for colleges with a tiered commission rate structure) if the bookstore did not experience the estimated sales losses. Once the appropriate commission rate was identified, it was applied to the projected sales losses to estimate the lost commission revenue at each college. In cases where the total sales plus OER-related losses did not reach the annual sales guarantee threshold, the commission revenue impact was set to zero for those reporting periods.³

The aggregate revenue losses bookstore sales commissions were then compared against the average annual commission revenue and total institutional revenue reported by the colleges.

Cost partner colleges: Institutional impacts. Data collected from five cost partner colleges provides information on the costs associated with developing OER courses and the OER degree pathway. This data, when combined with student-level data showing OER's impact on credit hours attempted and retention, also yields estimates of the financial return on investment (ROI) from OER.

OER program costs and funding. The cost partner colleges provided detailed information on their program revenues and expenses. They reported all sources of program funding (college budgets; foundation grants; state and local government, or other sources); reporting was *not* limited to grant funding for participation in the ATD OER Degree Initiative. Operating expenses included technology,

³ Alternate calculations tested the potential impact of other OER courses that are not part of the ATD Degree Initiative. When calculating sales per enrollment, students in these courses were not excluded because that enrollment information was outside the scope of data our collection. The alternate calculations are based on savings estimates from the blended textbook price and the percent of students purchasing materials at the campus bookstore. The commission rate was applied to these sales totals using the same procedure as outlined above. This approach produced sales loss estimates that were of a similar magnitude to the initial approach, suggesting the inclusion of these other OER courses did not have a significant impact on our results.

marketing, professional development expenses, stipends, travel, and other expenses. Personnel costs were estimated using an activity-based cost method as described below.

Administrative and academic support costs were estimated by multiplying the average hours per week spent on OER Degree Initiative-related activities by hourly salary costs. Each college's benefit rate was then applied to estimate total compensation costs.

OER course development costs were derived from faculty time logs and average salary and benefit rates. Instructors developing ATD OER courses were provided with time logs to record the weekly hours spent on various types of OER course development activities. At the end of each reporting period, the colleges provided rpk GROUP with aggregated information from the faculty time logs, which included instructor names, course names, the primary and secondary type of OER instructors used (open textbook; adapted existing OER material; created new OER material; open online learning technologies such as Waymaker or MyOpenMath), the types of courses converted (new or existing), and the hours instructors spent in each category of course development activity (see Figure 18 in the report).

Instructors' hours were multiplied by the average hourly salary rate for each instructor's position; the college's benefit rate was then applied to estimate total compensation costs. rpk GROUP then aggregated instructor-level information up to the course level for those instructors working in teams. Course-level hours were also aggregated across reporting periods to compile the total hours/compensation for each OER course developed by the cost partner colleges.

Total OER program costs were derived by summing personnel costs, instructor course development costs, and other operating expenses.

Return on Investment (ROI). A return on investment was calculated for the five cost partner colleges. ROI was calculated as the financial return to the colleges from the impact of OER on credits attempted. These financial returns were compared against colleges' OER program costs and the additional instructional delivery costs that arise from increased course taking.

Academic impacts. SRI provided rpk GROUP with estimates of the relationship between OER participation and the number of student credit hours attempted (see Table E2). SRI's analysis of credits attempted followed the same methodology as described for the academic impact analysis on GPA and credits completed. The ROI analysis relies on credits attempted instead of credits completed because taking additional credit hours generates new tuition and fee revenue for colleges. Credits completed does not have the same financial impact for colleges because students pay for credit hours whether or not they complete their courses.

Revenue calculations. Revenue impacts were calculated for each cost partner that showed a statistically significant relationship between OER and credits attempted:

1. Data reported on OER enrollments across the grant period were converted from duplicated enrollments into student enrollments to provide comparability with the student-based impact analyses. A weighting factor was derived using the distribution of students by the number of OER courses in which they enrolled. The weighting factor was applied to duplicated OER enrollments in Lumen-certified courses.

2. The number of additional credit hours OER students attempted (see Table E2) was multiplied by the number of OER students. The total credit hours were then multiplied by the average tuition and fees per credit hour reported by the colleges, resulting in total gross revenues.
3. An industry standard factor of 45% was applied to gross revenues to estimate the additional instructional delivery costs associated with an increase in credits attempted.

Impact analyses for four of the five cost partners tested a low dosage OER threshold, meaning the analysis sample only included students that enrolled in one or two OER courses. The ROI analyses applies the impacts for the low dosage students to students with three or more OER courses, which may represent a conservative impact (on students and revenues). For these analyses, both low and high dosage students are included in the revenue calculations.

One cost partner met SRI's conditions for a high dosage analysis. SRI provided a second analysis for this college to separately estimate the financial benefit associated with low dosage impacts. The impacts are separately estimated for the high and low dosage groups to avoid overestimating the financial impacts at this college by applying high dosage results to low dosage students. The supplemental low dosage analysis also ensures the financial impacts are not underestimated by excluding low dosage students from the ROI analysis.

The ROI is calculated as the gross revenue divided by total costs, which includes OER program costs and additional the instructional delivery costs associated with increased credit hour activity. The percentage return can also be calculated as (gross revenue – total costs)/total costs.

Outcome: Cumulative Credits Attempted

Impact estimates (β) are reported as unstandardized coefficients of students' cumulative credits attempted, meaning they can be interpreted as credit counts. For example, an impact estimate for Treatment of 3.0 would indicate that a Treatment student was estimated to attempt 3.0 more credits than an otherwise identical Control student.

Table E2. Credits Attempted Analysis

	Pierce College		Santa Ana College		Austin CCD		Montgomery College				Monroe CC	
	(Low Dosage)		(Low Dosage)		(Low Dosage)		(Low Dosage)		(High Dosage)		(Low Dosage)	
Variable	β^a	SE	β^a	SE	β^a	SE	β^a	SE	β^a	SE	β^a	SE
Treatment (Yes = 1)	2.97*	1.14	4.72*	0.35	1.04	0.76	2.05*	0.52	5.39*	0.91	-1.07	2.06
<i>Effect size^b</i>	0.11		0.26				0.18		0.49			
<i>Student demographic variables</i>												
Gender (Male = 0)	-4.07*	1.12	0.69*	0.35	1.14	0.70	1.99*	0.51	1.03	0.85	0.07	2.12
Race/Ethnicity (URM = 1)	2.13	1.21	-4.55*	0.53	-0.41	0.67	-0.88	0.58	-0.90	0.91	-0.28	2.37
Age (constructed from year of birth)	0.03	0.10	-0.09*	0.04	0.07	0.08	0.02	0.07	-0.06	0.10	-0.38	0.27
Pell status (Yes = 1)	-1.56	1.31	0.35	0.35	--	--	0.55	0.53	-0.25	0.83	-3.12	2.19
First generation (Yes=1)	-0.41	1.17	--	--	1.08	0.81	--	--	--	--	2.93	2.11
Veteran (1=Yes)	5.28	4.81	--	--	1.18	2.08	--	--	--	--	--	--
English language learner (Yes=1)	--	--	--	--	-0.71	1.31	--	--	--	--	--	--
Part-time enrollment (Yes=1)	--	--	-13.31*	0.40	-13.48*	0.75	-10.80*	0.53	-11.03*	1.14	-7.07*	2.55
<i>Transcript variables</i>												
# Semesters enrolled	20.97*	0.53	--	--	8.02*	0.25	9.92*	0.38	10.43*	0.70	--	--
Starting term, first eligible semester (ref.)	0.00	0.00	0.00	0.00	0.00	0.00	--	--	--	--	0.00	0.00
Starting term, second eligible semester	-1.64	1.56	-13.75*	0.64	0.97	0.81	--	--	--	--	-7.04*	2.22
Starting term, third eligible semester	8.52*	1.80	-11.68*	0.52	--	--	--	--	--	--	--	--
Starting term, fourth eligible semester	--	--	-25.48*	0.40	--	--	--	--	--	--	--	--
<i>Prior achievement variables</i>												
English placement score	--	--	--	--	--	--	--	--	--	--	--	--
Math placement score	.057*	0.01	0.99*	0.15	0.04	0.02	0.08*	0.01	0.12*	0.02	--	--

Variable	Pierce College		Santa Ana College		Austin CCD		Montgomery College				Monroe CC	
	(Low Dosage)		(Low Dosage)		(Low Dosage)		(Low Dosage)		(High Dosage)		(Low Dosage)	
	β^a	SE	β^a	SE	β^a	SE	β^a	SE	β^a	SE	β^a	SE
Campus variables												
Campus 1 (ref.)	0.00	0.00	--	--	--	--	--	--	--	--	--	--
Campus 2	-4.40*	1.57	--	--	--	--	--	--	--	--	--	--
Campus 3	1.01	1.27	--	--	--	--	--	--	--	--	--	--
Valid Control Records for Impact Analysis	168		2993		420		327		171		93	
Valid Treatment Records for Impact Analysis	192		2141		152		289		76		59	
Model R-Squared	0.85		0.55		0.77		0.71		0.71		0.17	

^a* $p < .05$.

^bWe report treatment effect sizes as Hedge's g in accordance with What Works Clearinghouse v4.0 Group Design Standards. We report effect size only for the Treatment variable. The Treatment effect size is reported only when the treatment is statistically significant at $p < .05$.

SRI Education

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