Next Generation Courseware Challenge Evaluation

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Executive Summary

In the last decade larger proportions of low-income, African American and Hispanic high school graduates have enrolled in postsecondary education programs. But their college degree completion rates have not kept pace. Ethnicity and income level gaps in bachelor's degree attainment did not shrink at all between 2005 and 2015.[1]

Research has shown that the number of credit-bearing courses that students complete successfully during their first few terms of college enrollment can predict whether or not they will earn a college degree. Students from low-income and under-represented minority backgrounds are especially likely to struggle with required developmental (remedial) and gateway (introductory) courses. When students drop these courses or earn a grade too low to count for credit toward graduation, they end up with fewer college credits in their initial year of college studies. For students from any background, those who do not succeed in accumulating 30 course credits in their first year of college are more likely to leave higher education without earning a degree.[2]

The Bill & Melinda Gates Foundation is committed to increasing the number of young adults from low-income and under-represented minority backgrounds who earn a postsecondary degree or credential. The foundation believes that one of the levers for improving students' likelihood of success in foundational college courses is the provision of better, more individualized learning opportunities. Over the last decade, the ability of digital learning systems to adapt to the prior learning, learning preferences, and mindsets of individual learners has expanded considerably. The Bill & Melinda Gates Foundation has been pursuing the question of whether adaptive courseware—digital content packaged as an entire course for delivery over the Internet—could enhance student engagement and outcomes in lower-division college courses, especially for low-income, first-generation, and under-represented minority students. But surveys of higher education administrators and instructors reveal that they continue to be reluctant to adopt digital courseware because of concerns around the time requirements that implementing it imposes on faculty, fears about losing control over course content, perceived misalignment between courseware designs and learning science principles, and uncertainty about courseware's efficacy in supporting student learning.[3]

To address the limited availability of affordable, high-quality adaptive courseware, the foundation launched the Next Generation Courseware Challenge (NGCC) in 2014. The intent of NGCC, as explained in the foundation's request for applications, was

1 Ma, J., Pender, M., & Welch, M. (2016). *Education Pays 2016: The Benefits of Higher Education for Individuals and Society.* New York: The College Board.

2 Attewell, P., & Monaghan, D. (2016). How many credits should an undergraduate take? *Research in Higher Education, 57,* 682-713.

3 Tyton Partners. (2015; 2017). *Time for Class: Lessons for the Future of Digital Learning in Higher Education.* Boston: Author.

to encourage the development and adoption of courseware that would "surpass what's currently available in terms of quality, price, scalability, learning science engineering, design excellence, and improvement of student outcomes." Through a competitive process, seven startup, nonprofit, and academic organizations received three-year grants to develop, iterate, refine, and scale the adoption of adaptive courseware products for higher education:

- Acrobatiq
- Cerego
- CogBooks
- Lumen Learning
- OpenStax (Rice University)
- Smart Sparrow
- Stanford Open Learning Initiative (OLI)

In addition to increasing the availability of high-quality courseware options, the foundation wanted to test whether such early-stage courseware companies would be able to implement and improve their products within a three-year timeframe using feedback from colleges, instructors, and students. And of course, the foundation wanted to test the viability of the hypothesis that the implementation of high-quality courseware could improve course outcomes for students.

At the time the NGCC initiative was launched, a reasonable number of research studies had compared the relative efficacy of different instructional modalities (online, blended, and face-to-face instruction), but fewer studies had evaluated the impacts of using adaptive digital courseware. Meta-analyses of the research literature generally found online learning to be equivalent to face-to-face instruction and blended or hybrid learning (a combination of significant amounts of both online and in-person learning) to be superior to both in terms of learning outcomes (Bernard et al, 2004; Means et al., 2010). But most of the studies in these quantitative syntheses did not involve whole courses. Several studies of college courses (both secondary analyses of higher education data and experimental studies) raised concerns over whether online and blended courses are a good match for the learning needs of low-income and under-represented minority students.[4] Further, William G. Bowen, president emeritus of Princeton university pointed out that while online and blended courses might increase access to higher education for a diverse group of students and reduce the costs of providing it, this effort could be counterproductive if these benefits are obtained at the cost of increased achievement gaps between different income and ethnic groups.[5]

The research studies that had been done at the time Bowen was writing his influential opinion piece did not involve professionally designed adaptive courseware. Such products were only starting to emerge in the higher education market, and independent tests of their effectiveness were yet to be done. A few years later, Yarnall, Means, and Wetzel conducted a study

4 Figlio, D., Rush, M., Yin, L. (2013). Is It Live or Is It Internet? Experimental estimates of the effects of online instruction on student learning. *Journal of Labor Economics, University of Chicago Press, 31*(4), 763-784; Jaggers, S. (2011). *Online learning: Does it help low-income and underprepared students?* Retrieved from Community College Research Center, Teachers College, Columbia University; Xu, D., & Jagger, S. S. (2011). The effectiveness of distance education across Virginia's community colleges: Evidence from introductory college-level math and English courses. *Educational Evaluation and Policy Analysis, 33,* 360.

5 Bowen, W. G. (2013). *Higher Education in the Digital Age.* Princeton University Press. Retrieved from http://www.jstor.org/stable/j.ctt24hrb1

of 16 early implementations of adaptive courseware.[6] That study found considerable variation in course outcomes for adaptive courseware compared to those of versions of the courses that had been used in the past. In launching the NGCC initiative, the foundation hoped to test whether newer adaptive learning courseware products, piloted and refined in the first phase of the initiative, would produce more consistently positive course outcomes than those found in the earlier adaptive courseware research.

SRI International, a nonprofit research and development organization, was retained to evaluate the NGCC initiative as a whole and to assist the grantees in conducting pilot and impact studies for the courseware they developed and marketed with NGCC funding. SRI maintained term-by-term records of student enrollment in course sections using each NGCC product, collected information on implementation challenges and supports through campus visits to pilot sites, advised grantee staff on impact study design, collected instructor perceptions through surveys, analyzed student-level impact data provided by the grantee organizations or their higher education partners, and performed cost effectiveness analyses for a subset of the courseware implementations.

Major Findings

Scaling

The NGCC courseware was used broadly and in a diverse set of higher education institutions. The seven NGCC grantees submitted data to SRI showing that their courseware was used by over 138,000 undergraduates and over 1,000 instructors in 449 different higher education institutions during the three-year period from 2015 to 2017. Over 40% of the institutions adopting the courseware were public two-year colleges with the remainder being a mix of public and private, traditional or online, four-year institutions.

Grantees employed different strategies for scaling adoption of their courseware. Some relied mostly on adoptions by individual faculty members, which aligns with the usual practice at most higher education institutions.[7] Other grantees pursued institutional adoptions by whole departments or programs. **The individual adoption strategy resulted in higher numbers of adoptions in the first portion of the grant period but by the end of three years, institutional adoptions reached the same cumulative total in terms of number of students reached.** This finding is important because institutional adoptions are difficult for new technology companies to negotiate but will be necessary if colleges and universities are to leverage adaptive courseware at scale to improve course success rates and persistence for low-income and under-represented minority students.

6 Yarnall, L., Means, B., & Wetzel, T. (2016). *Lessons Learned from Early Implementations of Adaptive Courseware.* Menlo Park: SRI International. Also funded by the Bill & Melinda Gates Foundation.

7 Tyton Partners. (2017).

Perceptions of Courseware Strengths and Weaknesses

Insights from Pilot Testing. When NGCC grantees rolled out their new courseware products to pilot campuses, they received feedback from students and instructors. In addition to this feedback, SRI researchers visited a number of pilot sites in order to observe courseware implementation and interview instructors, and researcher's observations were shared with the developers. We found that **both instructors and students involved in the pilot testing reported liking the interactive elements of next-generation courseware and the adaptive formative assessments embedded within the courseware.** At the same time, pilot experiences revealed a number of improvements that instructors and students wanted to see the in the courseware:

- In some cases, instructors and/or students wanted more guidance on how to use the courseware before starting to work with it.
- Some instructors wanted the capability to modify the courseware to better fit the learning objectives they had for the course or to adjust the software's mastery criterion to one they deemed more appropriate for their students.
- Using courseware products on mobile devices was found to place some limits on use of interactive media and ability to work on complex problems.
- Many students did not use courseware-embedded review functions as intended. This may have been because the software did not force them to review material they had not mastered, and students prioritized getting through the courseware module as quickly as possible (rather than maximizing their learning long term).
- Instructors did not always leverage all of the courseware's capabilities, suggesting the need for more instructor training and support.

As the foundation had intended, **NGCC grantees refined their products in response to this kind of feedback from their early users.** However, in some cases there was not time to make the refinements in products prior to initiating the courseware impact studies.

After the initiative's pilot phase, instructor perceptions surrounding the courseware and their experiences implementing it were gathered through a survey that SRI conducted in fall 2016 with additional survey waves for new instructors in spring 2017 and fall 2017 in cases where the instructor's class data were expected to be part of an impact study. The survey response rate was a healthy 78%, with 550 NGCC instructors completing the survey.

Instructor Preparation for Teaching with Courseware. The instructor survey provided a profile of the course instructors who used NGCC products. Of these instructors, 73% were teaching full time, and 52% were tenured or in a tenure-track position. Survey responses indicated further that the majority of instructors (70%) had volunteered to use the courseware. Their main motivations for doing so were the beliefs that it would increase students' engagement with course content and that it would enable them to do more individualizing of instruction. Two-thirds of the NGCC instructors had taught an online or blended learning class before, and a similar percentage (69%) felt that they had been adequately or well prepared to implement the courseware. Instructors did not spend an inordinate amount of time preparing to teach with the courseware. They

reported spending an average of 8.37 hours learning to use the courseware and 16.24 hours integrating the courseware into their courses.

Instructor Perceptions of Courseware Impacts. After using the courseware, a majority of NGCC instructors felt that it had improved teaching and learning in their class:

- 63% agreed or strongly agreed that the courseware supported students in deeper learning,
- 63% agreed it increased student engagement with course content,
- 57% thought it enabled better monitoring of individual student progress,
- 53% said it resulted in better tracking of whole-class progress, and
- 52% agreed that content was presented more effectively with the courseware.

Most instructors agreed that using the courseware provided the following benefits for their students' learning:

- better understanding and remembering of course content (66%),
- staying more engaged with the course overall (64%), and
- better analysis and application of course content (62%).

Overall, **the great majority of NGCC instructors reported being either moderately or highly satisfied with the courseware** (88%). These very positive instructor responses were especially noteworthy in light of prior reports in the literature. In addition to the overall dim views of courseware on the part of higher education administrators and faculty documented by Tyton Partners, the earlier SRI evaluation of adaptive courseware found that fewer than half of the instructors surveyed in that study planned to use the adaptive courseware they had tried out in the future.[8] In contrast, **80% of NGCC instructor respondents said they planned to use the NGCC product in their course in the future**. In terms of the faculty negative perceptions of courseware in general found by Tyton Partners, The NGCC products appear to have surmounted some of the specific courseware drawbacks cited by faculty surveyed by Tyton Partners: They were flexible enough to accommodate many different models of blended and online learning, thereby mitigating instructor concerns about loss of control over one's course and imposition of an inappropriate pedagogy. NGCC instructors' perception of positive impacts on student learning and their plan to use the courseware in the future suggest further that skepticism about courseware effectiveness and the burden that implementing it places on faculty were not an issue for the instructors who tried out NGCC products.

Yet despite NGCC instructors' quite favorable responses to the courseware products they had used and their intention to keep using them, they were not as enthusiastic as one might expect in their responses to a question about whether they would recommend the courseware they had used to a friend or colleague teaching the same course (average response 6.52 on a scale from 0 = Extremely Unlikely to 10 = Extremely Likely). To inform efforts to build a market for adaptive courseware, future research should probe for reasons why instructors are not more likely to recommend a courseware product they like to others in their field.

8 Tyton Partners, 2015; 2017; Yarnall, Means, & Wetzel, (2016).

Effects of Courseware Implementations on Students' Course Grades

NGCC grantees and the higher education institutions working with them submitted courseware implementation datasets to SRI. Each dataset contained student-level variables (gender, race/ethnicity, Pell status, age, first-generation college goer, full- or part-time enrollment, prior attempts in this course), a prior achievement measure (typically, college grade point average), and a common outcome measure (almost always course grade) for students in "treatment" course sections using the NGCC courseware and comparison or "business-as-usual" sections of the same course that did not use the courseware. Analysts identified the subset of these datasets that met predetermined criteria for inclusion in impact analyses (i.e., having enough students in each condition and having students in the two conditions who were reasonably similar to each other before the course began). Twenty-eight of the NGCC datasets met both of these criteria.

After applying statistical modeling to control for differences between treatment and comparison conditions in terms of student characteristics and prior achievement, analysts found that **NGCC courseware effects on student grades varied widely,** as shown in Figure ES-1. Students using the NGCC courseware earned significantly higher grades than those in the comparison or business-asusual versions of the course in 10 of the 28 impact studies (those with boldface labels in the figure).[9]

In seven of these cases, the effects of courseware implementation were sizable enough to have practical consequences. With positive effect sizes of .30 or greater,[10] **this quarter of the NGCC courseware implementations had impacts equivalent to moving an average student at the 50th percentile in course performance to the 62nd percentile or higher.** On the other hand, 4 of the 28 NGCC course implementation impact studies found a statistically significant negative effect. In the other half of the datasets, student grades in the two conditions were statistically equivalent after controlling for differences in student characteristics, such as full-time enrollment and prior grade point average.

When positive, negative, and no-difference results across the different products, institutions, and courses were averaged together, **the mean NGCC courseware impact on grades was small but positive and statistically significant.** The average NGCC courseware effect size of +0.09 was equivalent to moving an average student at the 50th percentile in the course (as it was taught in the past) to the 54th percentile through the implementation of NGCC courseware. The size of this average impact was similar to that found by Yarnall, Means, and Wetzel for 12 implementations of earlier versions of adaptive courseware.[11]

To address the foundation's goal of improving course success and graduation rates for low-income and under-represented minority undergraduate students, we next performed separate analyses of courseware

9 The criterion used for statistical significance was the customary $p < .05$, meaning that a difference as large or larger than the observed difference would be found merely by chance in fewer than 1 out of 20 repetitions of the same study if the populations of treatment and comparison students did not differ in course performance.

10 An effect size is the difference between the treatment and the comparison group average expressed in standard deviation units.

11 Yarnall, Means, and Wetzel (2016).

impacts for these student groups for those data sets with adequate numbers of low-income and under-represented minority students in each condition (7 data sets for low-income students and 10 for under-represented minority students).

On average, low-income students using NGCC courseware had grades that were +0.10 standard deviation higher than those of low-income students in the business-as-usual versions of the course, an average effect size that was almost identical to that for students overall. Although this difference in grades, like that for students overall, is small in magnitude, it does show that **low-income students' learning wasn't undermined by using courseware.**

The results for under-represented minority students (African American or Latino) were even more encouraging. The average courseware impact on under-represented minority students' grades was an improvement of +0.16 standard deviation units, a statistically significant effect. An effect size of 0.16 is equivalent to an under-represented minority student at the 50th-percentile student in the traditional course moving to the 56th-percentile through the use of the NGCC courseware.

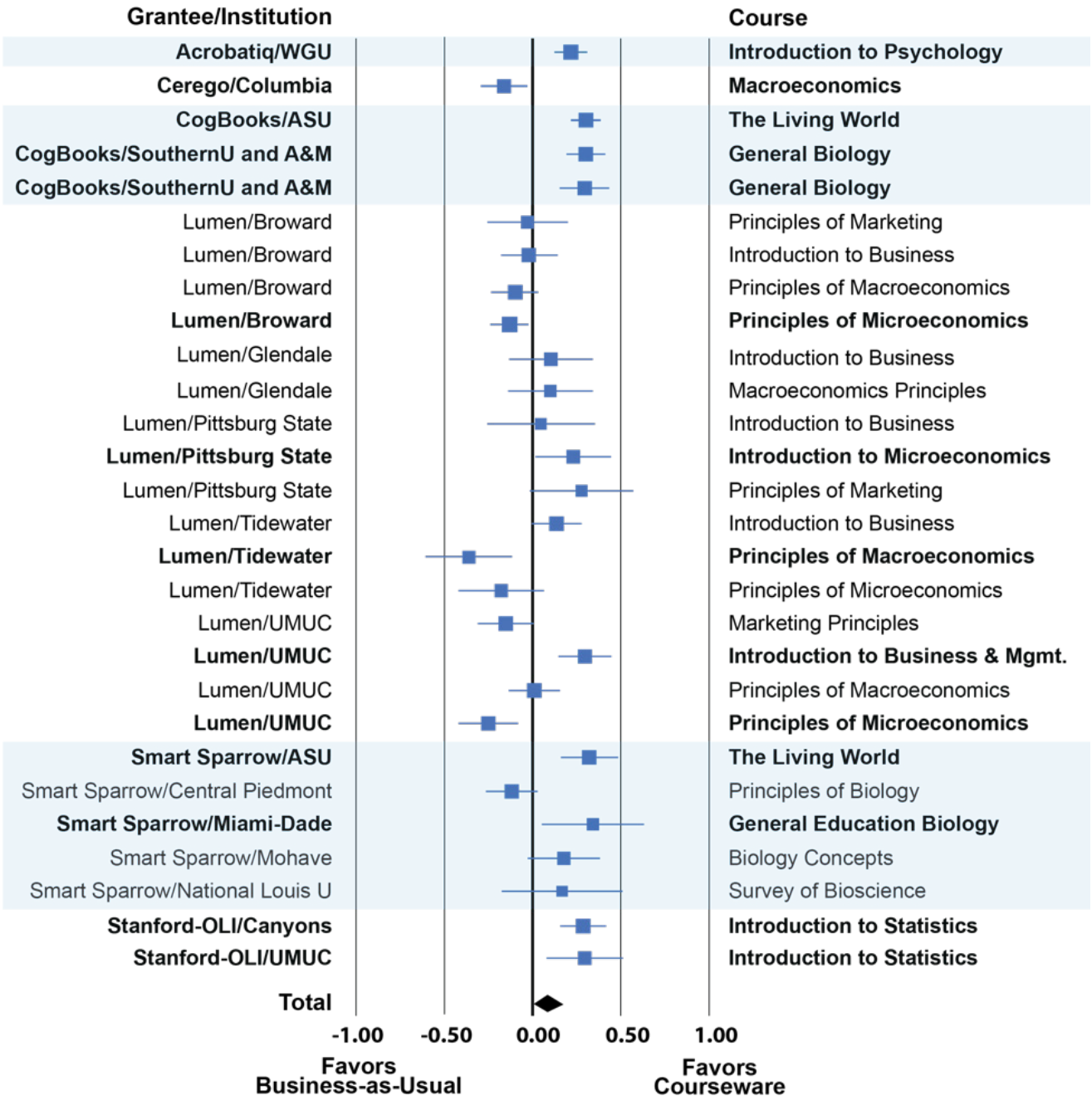
Figure ES-2 shows the distribution of impact findings (positive, neutral, or negative) for under-represented minority and low-income students in the individual courseware implementations in this analysis. **Half of the impact estimates for under-represented minority students were significantly positive; and each of these studies found an impact greater than +0.20 standard deviations.** Only one courseware implementation study found a statistically significant negative impact for underrepresented minority students.

Stronger evidence of the impact of new course designs could be amassed if higher education institutions set up experimental designs with random assignment to different versions of the course. But even in the absence of a large number of rigorously designed studies, the preponderance of evidence from the 28 NGCC controlled comparison studies addresses one of the concerns educators express about adaptive courseware: **Students learn at least as well in courses modified to incorporate adaptive courseware as they do in prior versions of the same course; nor does courseware exacerbate achievement gaps for low-income or under-represented minority students.**

Still, it is important to move beyond average effects to try to understand (1) when and under what circumstances implementing adaptive courseware will actually improve student outcomes and (2) how to adapt courseware products and implementation practices to obtain more consistently positive learning outcomes.

This level of variability in the impact estimates overall and for student subgroups suggests that improving student outcomes is not just a matter of finding the right courseware product. Despite the design qualities built into the NGCC products, those with larger numbers of impact studies (Lumen and Smart Sparrow) found positive impact in some cases but not in others. The way in which courseware is implemented—the amount of support instructors receive for using it, the role that instructors give the digital learning resources in their course, the fit between courseware content and the assessments that grades are based on, and the appropriateness of courseware content for the particular set of students in a course section—may all influence student outcomes.

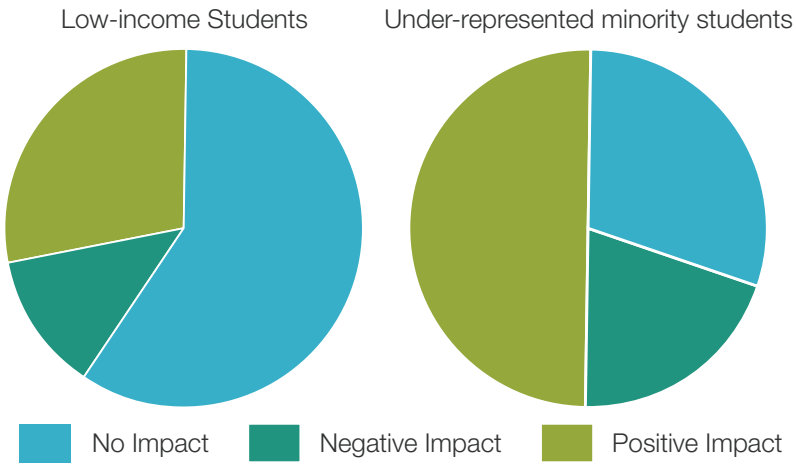
Figure ES-1. NGCC courseware impact estimates for 28 implementations



The square for each courseware implementation represents the estimated impact (effect size). The size of the square represents the weighting of the study in the meta-analysis. The length of the horizontal line through the square represents the confidence interval around the impact estimate. The longer the line, the more uncertainty there is around the true impact of the courseware implementation. The diamond at the bottom of the graph represents the average effect for the 28 courseware implementations. Its width represents the 95% confidence interval for the average impact.

Squares to the right of the boldface vertical line represent studies in which students in the courseware sections outperformed students in the business-as-usual sections. Squares to the left of the boldface vertical line represent studies in which students in the business-as-usual courseware sections outperformed students in the courseware sections. Only those courseware implementations with boldface labels are statistically significant (i.e., we can be confident that the difference in average grades for students in courseware and business-as-usual course sections did not occur by chance).

Figure ES-2. Percent of studies with various impacts on grades for low-income and under-represented minority students



NGCC impact estimates were examined further to glean insights into the conditions and practices associated with more and less effective courseware implementations. These analyses were strictly exploratory and should be interpreted as such because many features of the courseware implementations were highly correlated with each other, making it difficult to ascertain what caused the patterns observed in the impact data. With this proviso, we note that across the NGCC products and institutions:

- **The average courseware impact estimate was significantly positive for implementations in four-year colleges and statistically insignificant in two-year colleges.** Nine of 16 courseware implementation studies conducted in four-year colleges (56%) found significantly positive impacts. Only 1 of the 12 studies conducted at two-year colleges produced significantly positive impacts, suggesting that more capacity building and research into implementation strategies need to be done in those settings. The disappointing impact findings for two-year colleges is somewhat surprising in light of previous findings that students and instructors at community colleges tend to have more favorable perceptions of adaptive courseware than do their counterparts at four-year institutions.[12]
- On average, the **implementations of courseware in biology, psychology, and math/statistics classes led to higher student course grades** than those earned in business-as-usual sections of the same courses. In contrast, on average the courseware impact appeared to be insignificant for business

12 Yarnall, Means, and Wetzel. (2016).

administration and economics classes (which were the subject area for two grantee products with impact data). To some extent the subject area findings may represent product rather than subject matter differences, but the pattern of stronger results for science and math courses is congruent with a nonsignificant trend found by Yarnall, Means, and Wetzel and with previously reported research indicating that digital learning has more positive impacts in STEM courses than in other subjects.[13]

- **The average courseware impact was significantly positive for implementations in which a blended or online version of the NGCC course was compared to a face-to-face version of the course,** but not when an online course using NGCC courseware was compared to another online version of the course. This is not to say that online courses using NGCC courseware were ineffective, but simply to note that on average they were not significantly more effective than other online versions of the same course. There were some notable exceptions to this pattern, especially, the Western Governors University online psychology course using Acrobatiq courseware.
- **Impact studies in which courseware-using sections had instructors who were full-time teachers had significantly positive impacts while those with part-time instructors did not.** Those impact studies where instructors using the courseware were all or mostly part-time employees were for the most part contrasting online sections using an NGCC product with online sections without the product. Courseware impacts were not related to whether sections were taught by regular faculty (tenured or tenure track) or by instructors or adjuncts.
- **Implementations in courses where instructors taught more than 50 students in the regular (comparison) classes led to more positive courseware impacts than those where the class sections were smaller.** This data pattern has not been reported earlier but makes sense given the limited amount of personal attention an instructor can give to students in a large, conventional class.

Cost Effectiveness of NGCC Courseware Implementations

To make good decisions about implementing particular instructional interventions, education decisionmakers need to understand the likely costs as well as the likely benefits. For courseware implementations that were part of impact studies, the SRI evaluation team sought information concerning the cost ingredients for both courseware and comparison course sections. These ingredients included instructor time devoted to various activities such as course planning and grading as well as time spent with students and costs of facilities, textbooks, software, and so on. Collecting this kind of detailed cost data is labor intensive, both for researchers and for the administrators and practitioners involved in supplying the information. SRI was able to obtain sufficient cost information to support a quantitative analysis of costs for nine of the impact studies.

13 Vo, M. H., Zhu, C., and Diep, A. N. (2017). The effect of blended learning on student performance at course-level in higher education: A meta-analysis. *Studies in Educational Evaluation, 53,* 17-28.

Analysis of these data employed a cost ingredients approach as described by Henry Levin and colleagues.[14] Initial startup costs for courseware implementation were spread across the number of terms a college anticipated using the product and included the value of instructor time, regardless of whether or not instructors were compensated for that extra time. **In 8 of the 9 cost analyses for NGCC courseware implementations, per-student costs were lower for the courseware-using version of the course than for business-as-usual.** Importantly, these cost savings were not achieved by reducing instructor time with students nor by compromising student learning. In 7 of the 8 cases where money was saved, student achievement actually went up compared to the comparison condition without courseware.

For the nine NGCC cases in our cost-effectiveness analysis, **use of NGCC courseware moved the average student's performance from the 50th to the 58th percentile while saving approximately $105 per student.** The cost savings found for these NGCC courseware implementations stemmed primarily from avoidance of textbook costs for students.

The NGCC data present a more positive picture of cost effectiveness than did the cost analyses conducted as part of the earlier SRI study of adaptive courseware implementations, in which only a single courseware implementation out of 16 achieved both better student outcomes and cost reductions.[15] Nevertheless, it should be noted that the findings described above represent total costs. If only costs to the higher education institution are considered, implementation of courseware in these nine cases entailed an average additional cost of $107 per student. This additional cost to the institution might be expected to decrease with subsequent iterations of courseware use, as was found when Yarnall, Means, and Wetzel looked at costs separately for three successive terms of adaptive courseware implementation.[16]

The Next Generation Courseware Challenge cost effectiveness findings come from a small number of cases that are not necessarily representative of the courseware experiences in higher education as a whole. Providing detailed cost data requires significant effort on the part of college staff, and institutions willing to make the effort tended to be those that had enjoyed more success with their courseware. **Nevertheless, these early cost effectiveness findings suggest that although courseware is no silver bullet, it is possible to implement it in ways that permit progress on both quality and cost.** Having proof that it is possible, the next step is understanding how best to implement courseware with different kinds of learners and to facilitate learning of a broader array of academic content in more diverse settings with similar cost effectiveness.

14 Levin, H. M., McEwan, P.J., Belfield, C., Bowden, A. B., and Shand, R. (2017). *Economic Evaluation in Education: Cost-Effectiveness and Benefit-Cost Analysis (3rd ed.).* Thousand Oaks, CA: Sage Publications.

15 Yarnall, Means, and Wetzel. (2016).

16 Yarnall, Means, and Wetzel. (2016).

Implications for Future Initiatives

The Next Generation Courseware Challenge generated both a great deal of data and valuable experiences for colleges, educational technology developers, researchers, and philanthropists with respect to the issues surrounding the implementation of digital courseware as part of a broader effort to close college attainment gaps.

The NGCC experience suggests that philanthropic backers of postsecondary courseware would benefit from reconceptualizing what they mean by scale. Market analyses emphasize the number of product users, but product use is not really the goal for higher education institutions and philanthropies. We should consider the multiple dimensions of scaling, which include the degree of penetration within an institution and the extent to which the institution has assumed ownership for the intervention as well as the number of institutions involved.[17] Moreover, we need to keep in mind the fact that **what we need to scale is not courseware use per se but practices that leverage courseware in ways that improve student outcomes.** We must continue to measure courseware impacts to identify cases where the implementation has been successful, but we then need to examine those cases in detail to identify and describe the policies, structures, and practices that enabled that success.

To inform further work on closing gaps in course success rates, **it would be helpful to conduct in-depth studies of the study behaviors and experiences of students from low-income and under-represented backgrounds in gateway courses with and without adaptive courseware.** Such studies could inform the product features and implementation of learning technologies so that the field can learn how to use adaptive courseware in ways that benefit low-income, first-generation, and under-represented minority students.

Similarly, **the field would benefit from a better understanding of the needs of two-year college instructors with respect to courseware implementation and of best support practices within community colleges that are implementing teaching and learning improvement efforts well.** The low number of community college courseware implementations with positive impacts on student course outcomes suggests that these institutions have not developed some of the organizational capacities and processes used in four-year colleges. At the same time, it should be recognized that community colleges are serving a different population and often do so primarily with part-time instructors. There is a need to develop models for growing the capacity to improve teaching and learning within community colleges and to document "proof of concept" cases from which other community colleges can learn.

The NGCC experience has implications for courseware market studies as well. Efforts to scale courseware through institutional adoptions may sacrifice user numbers in the short term, but have advantages in the longer term. NGCC scaling data suggest that it may take three years for the institutional scaling strategy to attain parity with the direct-to-faculty strategy in terms of user numbers. But what these numbers do not reveal is the greater capacity for department-wide course redesign and for measuring courseware impacts in institutions that

17 Coburn, C. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher, 32*(6), 3-12

are undergoing wholesale adoption of courseware. **To the extent that courseware is intended to be a stimulus for significant changes in college programs and pathways, institutional adoptions (at least program or department-wide) will be necessary.** At the same time, it should be acknowledged that institutional-level courseware implementations are much more challenging. They require involvement and agreement among many more players and mean that the instructors who will be using the courseware cannot be limited to those who are enthusiastic about doing so.

Implementing courseware at scale in ways that enhance student outcomes at the institutional level is the next big challenge, and it appears to be one that will be particularly perplexing for community colleges. To have a practical benefit for students and higher education institutions, courseware needs to be implemented—and implemented well—within a critical mass of the college's courses. This need suggests that the field would benefit from knowledge about how a college or university can move beyond working with those instructors who are early adopters and still get good results for students. Close examination of successful efforts to do this would be extremely helpful as we try to make progress toward achieving consistently positive outcomes at scale. An evidence-driven deeper dive into instructor quality, instructional practices, student and instructor supports, and students' own behaviors and perspectives is needed.

More direct engagement between researchers and higher education institutions appears necessary both to improve the quality of impact evidence and to enhance organizational capacity. In the course of conducting the NGCC and prior postsecondary learning technology evaluations, we have found that the majority of higher education institutions do not measure the learning impacts or per-student costs of incorporating learning technology into their courses. Nor do learning technology developers typically conduct rigorous studies of the impacts their products have in learning. The NGCC grantees should be commended for their willingness to submit their early products to evaluation studies they knew would be made public. Lumen Learning was particularly notable in this regard, submitting 16 of the 28 data sets with adequate numbers of comparable students in treatment and comparison conditions to enable estimating the impact of the courseware implementation. But the field should not rely on learning technology product developers and vendors to perform needed studies of impact. Ideally, colleges and universities themselves would employ evidence-based decision-making and iterative improvement processes as they embrace digital learning. Getting more consistent, credible impact evidence for courseware will require having researchers, instructional designers, and faculty collaborate on redesigning courses to foster active learning and on articulating and measuring the impact of redesigned courses on student outcomes and costs.

Courseware impact studies should expand their focus to encompass longer-term student outcomes, including persistence and credit accumulation over time, as well as course grades and credits. The foundation has amassed course outcome data for scores of courseware implementations over the last eight years. While useful, this database by itself does not answer questions about progress against the foundation's goal of increasing the proportion of low-income

and under-represented students who attain college degrees or other marketable credentials. The foundation has taken the important step of sponsoring a framework of near, medium, and long-term key performance indicators at the institutional level. The next step in understanding how courseware use can impact these aggregate performance indicators will be longitudinal studies of student cohorts to address questions about how students who experienced well-implemented adaptive courseware in their gateway courses perform relative to other students in terms of credit accumulation, retention, grade point average, and success in subsequent courses in their major or pathway. Only by conducting well-controlled longitudinal studies of student outcomes can we understand whether or not the investment in digital learning is having the intended long-term payoff that is necessary for improving students' lives.

Introduction

The Next Generation Courseware Challenge (NGCC) of the Bill & Melinda Gates Foundation is part of the foundation's strategy to increase the number of young adults from low-income and under-represented minority groups who earn a postsecondary degree or credential. The reasoning behind the initiative is that higher-quality, more personalized learning opportunities in a student's initial college courses should result in higher course completion rates, with positive impacts on credit accumulation and hence college completion. The foundation wanted to explore the question of whether the digital learning systems that are becoming increasingly adaptive and capable of providing an array of learning activities could produce higher success rates for students in general, and for low-income and under-represented minority students in particular, in entry-level college courses.

To address both the supply and the demand side of the digital courseware market, the Bill & Melinda Gates Foundation launched the NGCC in 2014.

The foundation distributed its RFI-RFP for the Next Generation Courseware Challenge to 109 innovative organizations, including digital learning providers, publishers, media organizations and postsecondary institutions in May 2014. Offerors were asked to describe how they would take on the challenge of designing, developing, marketing, and delivering exemplary courseware for undergraduates in core general education courses.

In describing what the foundation was looking for in "next-generation" courseware, the NGCC request for information and proposals (RFI-RFP) explained that such courseware would "surpass what's currently available in terms of quality, price, scalability,

Definition of Digital Courseware

The foundation has elaborated on Tyton Partner's (2014) definition of courseware. This definition, below, explicitly excludes learning management systems because they are not course content per se.

Courseware is "digital content, assessments and interactives, delivered over the Internet, which are packaged and distributed as a complete course (e.g., not a partial course, unstructured learning objects, or an optional course supplement). High-quality courseware includes multiple components, including expert-sourced learning outcomes, modular and extensible interactive learning modules and curricula architected and designed for continuous improvement and learner feedback, integrated formative assessments and course summative assessments, instructional resources and help modules supporting student and faculty use and adoption of the courseware."

--- Bill & Melinda Gates Foundation, NGCC RFI-RFP, 2014, p. 3.

learning science engineering, design excellence, and improvement of student outcomes."

The 15 attributes of high-quality next-generation courseware identified by the foundation are shown in the sidebar.

Sixty organizations submitted preliminary NGCC proposals in response to the RFI-RFP, and the foundation selected 18 of these as finalists. The finalists then prepared more detailed proposals and gave an in-person presentation to a panel of five foundation staff and five external advisors at the foundation's offices in Seattle. Using scoresheets from these panelists, the foundation selected seven organizations to receive three-year NGCC grant awards of $1-4.5 million starting in January 2015:

- Acrobatiq
- Cerego
- CogBooks
- Lumen Learning
- OpenStax (Rice University)
- Smart Sparrow
- Stanford Open Learning Initiative (OLI)

Attributes of High-Quality, Next-Generation Courseware

1. Includes student-facing digital content for a complete course
2. Designed for online and/or blended learning scenarios
3. Based on cognitive and learning science research
4. Designed to stimulate effective instructional practice and pedagogy
5. Provides a user experience that sets a new bar for ease of use, elegance, user engagement, and support for learner and instructor insights
6. Powered by rigorous and defensible articulation of learning outcomes, driving continuous improvement and refinement of both the learning content and assessments
7. Integrates dynamic and creative embedded assessments to promote mastery as well as summative assessments aligned to the course subject area
8. Permits faculty to customize, align, add or subtract content and instructional experiences for their specific educational context and learners
9. Reflects advances in adaptive learning to scaffold and accelerate a learner's mastery and progression
10. Conforms to best-in-class technologies and interoperability standards, learning accessibility standards, and web design
11. Exceeds field-recognized course design rubrics such as Quality Matters and ACE CREDIT Course Review
12. Optimized for multiple delivery modes including mobile, tablet, and desktop
13. Provides best-in-class faculty and learner real-time assistance, support, and help
14. Enables communities and groups of learners to support and assess each other
15. Optimized for machine learning or data mining to generate learner and user analytics

The Foundation's Strategy for Supporting Development and Spread of Next-Generation Courseware

At the time the NGCC initiative was launched, a reasonable number of research studies had compared the relative efficacy of different instructional modalities (online, blended, and face-to-face instruction), but fewer studies had evaluated the impacts of using adaptive digital courseware. Meta-analyses of the research literature generally found online learning to be equivalent to face-to-face instruction and blended or hybrid learning (a combination of significant amounts of both online and in-person learning) to be superior to both in terms of learning outcomes (Bernard et al, 2004; Means et al., 2010). But most of the studies in these quantitative syntheses did not involve whole courses. Several studies of college courses (both secondary analyses of higher education data and experimental studies) raised concerns over whether online and blended courses are a good match for the learning needs of low-income and under-represented minority students (Figlio, Rush, & Yin, 2010; Jaggers, 2011; Xu & Jagger, 2011). Further, Bowen (2013) pointed out that while online and blended courses might increase access to higher education for a diverse group of students and reduce the costs of providing it, this effort could be counterproductive if these benefits are obtained at the cost of increased achievement gaps between different income and ethnic groups.

The research studies that had been done at the time Bowen was writing his influential opinion piece did not involve professionally designed adaptive courseware. Such products were only starting to emerge in the higher education market, and independent tests of their effectiveness were yet to be done. A few years later, Yarnall, Means, and Wetzell (2016) conducted a study of 16 early implementations of adaptive courseware.[18] That study found considerable variation in course outcomes for adaptive courseware compared to those of versions of the courses that had been used in the past. In launching the NGCC initiative, the foundation hoped to test whether newer adaptive learning courseware products, piloted and refined in the first phase of the initiative, could improve student learning outcomes at scale, especially among low income and under-represented minority students.

Terms of the NGCC grants required not only developing exemplary next-generation courseware for high-enrollment, lower-division college courses but also enlisting a high number of colleges and universities to use these products and collecting the data needed to (1) provide feedback on the usability and quality of the products in the initiative's first phase and then (2) to ascertain the impacts of the courseware on student learning and the attainment of course credit. The foundation was laying out a major challenge by setting these multiple goals, but the organizations invited to bid already had digital learning products, and the assumption was that they would be extending and refining those products rather than starting from scratch. The key premise linking these activities to the foundation's goal is that courseware incorporating the next-generation quality

18 Also funded by the Bill & Melinda Gates Foundation and available at https://www.sri.com/sites/default/files/brochures/almap_final_report.pdf.

features would improve outcomes for low-income and disadvantaged students receiving access to it.

Another challenge implicit in the foundation's RFI-RFP was the development of new business models because the foundation required grant applicants to explain how the courseware they developed under the grant would be made available to those learners most in need at low or no cost, and also to explain how their organization would be sustained financially after grant funding ended.

To support the grantees' Next Generation Courseware Challenge work, the foundation engaged the services of several additional organizations. SRI International was tasked with evaluating the NGCC portfolio as a whole and with helping each of the grantees design and execute pilot and impact studies. The consulting firm Intentional Futures was engaged to help grantees incorporate user experience perspectives into their design and development work and to provide technical assistance around marketing strategies. Tyton Partners was contracted to develop a framework for assessing courseware quality and to conduct a follow-up survey of college faculty and administrators to capture their satisfaction and concerns around courseware adoption. Subsequently, EdSurge was engaged to develop an online digital learning community and dissemination portal for information on postsecondary digital learning. Since then, additional organizations have joined the broader collective effort to increase postsecondary success through the Every Learner Everywhere network.

The NGCC grant terms required grantee organizations to carry out pilot testing in the first phase of their grant and subsequently to work with SRI to design and implement data collections during later courseware implementations that could be used to estimate the impacts of courseware usage on student course completion and learning outcomes. The NGCC research and evaluation activities were based on the foundation's Courseware R&D Evaluation Framework (Means, Peters, & Zheng, 2014). That framework posits four goals for evaluation support:

- Support design and development of potentially powerful courseware and tools;
- Understand the "wrap around" needed to get positive results using the courseware (implementation research);
- Determine consistency of positive outcomes when implemented at scale; and
- Assess cost efficiency.

The remainder of this report first addresses the development and scaling of grantees' NGCC products and then addresses the latter three elements of the evaluation framework.

NGCC Courseware Development and Refinements

The following pages provide brief descriptions of each NGCC grantee's courseware as well as links to web sites with additional information.

Acrobatiq – acrobatiq.com

Launched from Carnegie Mellon University (CMU), Acrobatiq uses an approach to technology-enabled learning grounded in the cognitive and learning science research of CMU's Open Learning Initiative (OLI). Acrobatiq combines an adaptive learning platform, courseware library, and professional services to enable higher education institutions to develop, scale, and evaluate personalized learning.

Courseware offered by Acrobatiq spans business and economics; computing and information technology; healthcare and nursing; humanities, social science, and education; and, mathematics and science. The courseware can be used in place of a traditional textbook, providing students with a more interactive learning experience and educators with real-time data on student learning performance. Acrobatiq's Statistics course, one of several courses being enhanced with NGC grant funding, is the most full-featured of the company's courseware releases to date.

Acrobatiq's course design framework aligns course content, activities, and assessments to learning outcomes. The courseware includes opportunities for students to demonstrate concept mastery via diagnostic, formative, and summative assessments. Practice questions are tailored to each student based on the current estimate of that student's learning state. Students with low levels of mastery are given more opportunities to practice, as well as multiple levels of hints and feedback aimed at specific mistakes or misconceptions. Interactivity is also a focus of Acrobatiq's courseware. Their newest courseware includes as many as 200 dynamic media elements and interactive exercises, such as manipulable images, to enhance learner engagement and understanding.

As students interact with Acrobatiq's courseware, learning data are collected, analyzed, and reported through an instructor dashboard in real time. Dashboards are organized around common questions educators have about student performance and are used to identify skills and concepts that students are finding difficult to master, pinpoint at-risk students, and provide targeted interventions as needed.

Acrobatiq's courseware conforms to learning tools interoperability (LTI) standards to support integration with learning management systems (LMS). It is also supported on mobile devices. Additionally, Acrobatiq offers an easy-to-use course authoring tools as part of the platform. The authoring tools enable educators and instructional design teams to collaborate and customize the courseware by incorporating new content using pre-formatted templates and prompts that promote sound design and assessment principles.

Cerego – cerego.com

Cerego provides technology to help users learn more efficiently. The company provides customizable courseware for postsecondary education, with offerings in statistics, macroeconomics, microeconomics, U. S. history, biology, anatomy and physiology, and sociology. In addition, Cerego licenses its technology to publishers, schools, companies and developers to help them create personalized learning and training experiences.

Cerego's technology draws from the learning science principles of "retrieval practice" and "distributed practice" to help students learn and retain foundational concepts. Each Cerego module or course unit consists of a "set" of concepts and definitions for which students must achieve a target level of retention. The desired retention level can be determined by instructors, and the system then prompts students to review concepts at spaced intervals to reach and sustain that level. The lengths of these intervals are not fixed, but adapt individually to each student depending on their learning and behavior. Students have access to a dashboard that displays their activity and progress data. They can access Cerego on mobile devices as well as PCs.

Cerego's courseware combines its core learning technology with interactive multimedia content developed by partners and third parties, such as statistics simulations from the CREATE lab at New York University and instructional content from OpenStax and other sources.

Cerego's courseware is designed to augment instructor-led instruction rather than as standalone course content. Instructors can select and modify modules that fit with their curricula and learning objectives. They also have access to dashboards displaying activity and progress data for students in their classes.

CogBooks – cogbooks.com

CogBooks has developed and provided adaptive personalized learning for over 15 years. It offers adaptive courseware in a range of scientific and liberal arts topics; major publishers also use CogBooks to deliver adaptive courseware to a global audience.

CogBooks emphasizes the application of cognitive science principles of learning. It aims to replicate the actions of an intelligent personal tutor, giving highly personalized support to students as they are studying. The core design principle behind CogBooks courses is uses of active or effort-based learning with periodic learning checks. Each course is broken down into short modules, with learning activities and quizzes that support students' ability to build knowledge and improve retention. At all times, adaptive feedback provides the student with a range of recommended activities to choose from, when they need extra help.

Instructors can use CogBooks courseware in a fully online or blended format, add or change content, customize the courseware, override built-in"the grading policies, and generally control the content presented to each student. The instructor dashboard allows educators to review the performance of individual students as well as the entire class. Instructors can also use a range of built-in class management and peer discussion tools. CogBooks integrates via LTI, allowing deep linking into LMS course shells and full gradebook integration.

Building on the success of the program (and with support from the Bill & Melinda Gates Foundation) CogBooks has partnered with Arizona State University to build a complete and integrated adaptive biology degree program. This program covers 20 biology major courses that can be used independently as adaptive courseware or as an integrated whole degree program. The adaptive degree delivers a seamless personalized learning journey for each student through their whole degree. The Biology Majors Courseware is now available for adoption by any U.S. postsecondary institution.

CogBooks also offers its cloud-based authoring and course-building platform to educators and publishers. The entire suite of tools allows authors to build, sell, and deliver adaptive courseware, and can be licensed to individual educators, a whole institution, or a publisher.

Lumen Learning – lumenlearning.com

Lumen Learning's courseware combines open educational resources (OER) with adaptive personalized learning software. Lumen courseware can be used to teach core content in face-to-face (flipped classroom model), blended and online modalities. Courses are available in Intro to Business, Macroeconomics, Microeconomics, and Intro to Marketing. Structured in modules, the content is presented in the form of text, multimedia, and simulations. Individual student learning plans are built as the learning system analyzes data gathered as the student works through the content, embedded formative assessments, assignments, and summative assessments. The learning plans make recommendations that allow both students and instructors to adjust and tailor their activities to support learning.

Lumen Learning courseware can be integrated into major learning management systems including Blackboard, Canvas, and Desire2Learn Brightspace. Faculty members can modify the course materials to fit the desired course session length (most often 8, 12, or 16 weeks).

The courseware also includes tools supporting instructor-student communications. Instructors receive automatically generated messages when students are struggling, including recommendations about which students would benefit from individualized outreach and where they need help. Instructors can use courseware tools to send customizable, automated messages with both positive feedback ("great job on that quiz!") and situation-appropriate notifications when a student falls behind.

OpenStax – tutor.openstax.org

OpenStax Tutor Beta is research-based courseware that integrates with three OpenStax textbooks: College Physics, Biology 2e, and Introduction to Sociology 2e. This courseware enables instructors to assign reading and homework assignments and includes a comprehensive assessment library for each discipline. OpenStax Tutor Beta is designed to enrich the student learning experience by integrating interactive elements, such as videos and simulations, and by using spaced practice and personalized questions.

Key features of OpenStax Tutor Beta include performance forecasting and assignment analytics designed to help instructors target their teaching and to help students engage in extra practice where they need it most. The courseware provides immediate feedback to students working through reading assignments and, at the end of each assignment, presents students with spaced practice and personalized questions.

Instructors can use OpenStax Tutor Beta in online courses or in blended formats. OpenStax Tutor Beta integrates with Blackboard, Canvas, Desire2Learn, Moodle, and Sakai learning management systems (LMSs).

A nonprofit based at Rice University, OpenStax provides free, peer-reviewed, openly licensed textbooks and low-cost courseware to help students learn.

Smart Sparrow – smartsparrow.com

Smart Sparrow is a learning technology company inspiring the next wave in digital learning and assessment. The Inspark Teaching Network is led by a partnership between Smart Sparrow and Arizona State University's Center for Education Through eXploration, which was initiated in response to the Next Generation Courseware Challenge of the Bill & Melinda Gates Foundation.

Inspark represents a collaboration between institutions of tertiary and secondary education, scientists, researchers, and education experts all working to transform teaching and learning. The network has created a series of courses enabling educators to collaborate, build, and share next-generation learning experiences. The courseware harnesses personalized, interactive digital learning technologies and focuses on active learning designed to spark student curiosity, discovery, and exploration.

Organizing learning as an exploration of the unknown is a hallmark of the Inspark Smart Course curricular design. Whole courses are organized around big driving questions, like whether we are alone in the universe. Students can access the Smart Sparrow platform directly on the web or through an institution's Learning Management System (LMS). Inspark teaching partners are now reaching almost 10k students a semester from some 60 institutions, at both 2-and 4-year colleges, with significant growth.

Courses created by Inspark and partners on the Smart Sparrow platform stand out in the market by their extensive use of virtual simulations, promotion of learning-by-doing, and high-quality graphics for science education. For example, HabWorlds features the Build-a-Planet simulation where students manipulate the level of properties such as gas, ice, and rock to build a planet that can sustain life. BioBeyond includes an immersive fly-through into the cell, which can also be offered in virtual reality. The suite of web-based software tools includes an adaptive learning platform and tools for developing learning content and applications, deploying that material to students, and analyzing how students learn from their responses to the material. Adaptive feedback is provided in different forms such as a hint, a video, a graph, or additional material triggered by a student's response to a question, the time spent on a screen, or the number of question attempts.

Instructors can use Inspark courseware to teach an entire course or they can select individual modules and activities for their classes. Because it's built on the Smart Sparrow platform, instructors have a dashboard which allows educators to review the performance of individual students or the entire class. Smart Sparrow's suite of tools can be licensed at the level of a single class, multiple classes, department, or institution.

Open Learning Initiative (OLI) at Stanford – oli.stanford.edu

The Open Learning Initiative (OLI) at Stanford is a grant-funded organization housed at Stanford University that offers openly-licensed, adaptive online courseware developed by and for institutions of higher education. OLI's stated mission is to provide high-quality online courses that are based on human learning research and that function as laboratories for continued learning sciences research. The open and free versions of the OLI at Stanford courses in statistics and computer science are available on Stanford's Open edX platform. OLI at Stanford collaborated with OLI at Carnegie Mellon on course design, improvement, and delivery for all of their partners. The academic versions of the courseware are available at oli.cmu.edu.

For the NGCC program, OLI implemented three statistics courses: Probability and Statistics, Statistical Reasoning, and Concepts in Statistics. All three statistics courses include expository text, simulations, case studies, comprehension tests, and the StatTutor lab. Complete instructions are included for the statistical software packages Microsoft Excel, Minitab, R (open source), TI calculator, and StatCrunch. Interactive learning exercises provide opportunities for practice and self-assessment and give students feedback while they are working on activities (and before being assessed for a grade).

A distinctive feature of Stanford's OLI statistics courseware in the incorporation of mindset interventions designed to help struggling learners develop a "growth mindset" that encourages them to develop their expertise through hard work on challenging tasks. Content and assessments are tied to learning objectives and skills. These skills feed a newly developed Open Analytics Research Service (OARS) that provides actionable feedback to learners, instructors, course authors and learning researchers using openly available and testable predictive models.

The NGCC Courseware Pilot Phase

The NGCC grants were structured to foster a data-driven, continuous improvement approach to courseware design and implementation. Recognizing that early versions of a product almost always have some "kinks" and that faculty may need some experience to learn how to make courseware an effective part of their classes, the foundation set up the first half of the three-year grants as a time for development and pilot testing. Grantees were expected to have at least early versions of their courseware products in use in college classrooms in academic year 2015-16 and to collect data from those early implementations that could be used to guide product refinements and to develop implementation guidelines for further work. Further, grantees were required to document the findings from their pilot studies and the ways in which they would use those findings in their subsequent activities.

All seven of the grantees met the milestone of having versions of their courseware in the field by spring 2016. Although they had limited time to make software changes before the next round of courseware implementations in academic year 2016-17, the NGCC grantees made significant changes in their products and/or their implementation guidelines in response to things they learned from pilot testing. One grantee, for example, changed the way their system handles adaptive practice. They moved from using a learning curve analysis of student performance to employing dynamic skill graphs developed through machine learning techniques. They also changed the way that their product introduces the concept of adaptive practice to students after finding a low rate of completion for the recommended practice items among pilot students.

Another grantee, after finding that students using their product on mobile devices made more progress than students not using mobile devices, decided to make their product a stand-alone mobile application. To handle the problem of synchronizing activity within their product with the pace of classroom instruction, this grantee created an option for the instructor to lower the mastery level for their learning modules and reduce the number of items in each module so that all students would be more likely to master a module within a week. They also deleted quantitative problems from their instructional modules. To further motivate students, they developed a student view of the learning goal, their current level, and the progress they made after every review session. Finally, they developed tools that instructors could use to edit the digital content to fit the particulars of their course.

A third grantee responded to students' desire for more guidance on how to use the courseware by developing user guides and additional supports including the ability for students to communicate with their instructor through the courseware. They also increased the number of assessment items and added more variety in item formats. To provide more support to instructors using their digital content in a blended course, they developed a set of course progress reports that instructors can download and use to inform their choice of what to work on during class time.

One grantee undertook a number of product refinements after their first implementations in the fall of 2015. Most importantly, they improved the alignment between their course content and their embedded assessments so that their mastery feature would function better. They also added a student orientation module to provide students with guidance on how to use the courseware. They reworked their multi-select assessment items as regular multiple-choice questions and gave instructors the ability to edit quiz items and to allow multiple quiz attempts if they wished. Finally, they developed a personalized study plan feature to encourage students to use the courseware resources to attain mastery.

In response to the pilot finding that only a minority of students used their product's concept learning modules at the end of book sections, one grantee is now recommending to instructors that they make weekly use of these modules a course requirement. They have also added an explanation of the value of spaced practice for students and in the future they will make it possible for students to repeat an activity. They have added links to relevant content on every page of their online text so students can see additional content as an overlay. Finally, they have revised their assessment items by removing those that were too easy or too hard and adding an explanation for two-step free response-multiple choice items (where students first respond to a question by filling in a text box and then choose the response option most like their free-response answer for a multiple-choice version of the question).

Another grantee removed the learner success module that students responded poorly to from their courseware and is in the process of reworking it. They have also redesigned their continuous scoring system and have developed implicit "triggers" for remediation when student performance suggests it is needed.

Finally, one grantee implemented the training for instructors new to teaching with their courseware that one of their pilot sites requested and added assessment items to their test bank. They also made changes that enable instructors to author and edit content. They are exploring the possibility of replacing the prompts for students to compare their answer with that of an expert with a report to the student of the system's estimate of his or her learning state.

The NGCC grantees made significant efforts to improve their courseware to address the needs and concerns that emerged during the first year of implementing their early-stage products. In our experience, the kinds of challenges they encountered during their first round of implementations are quite typical, and other developers should expect similar hiccups and the associated insights to emerge during their own early field testing. These findings underscore the importance of early pilot testing in real classrooms. The NGCC grantees should be commended for their openness concerning the areas for improvement revealed in these early implementations as well as for their efforts to make rapid improvements in their products even as they were working against aggressive scaling targets.

General themes running through the NGCC pilot findings described above highlight areas where it is common for early learning technology products to have room for improvement:

- More orientation needed to how to use the courseware
- Assessment items that were confusing or had inappropriate difficulty levels
- Lack of ability for instructors to modify content, assessment items, and mastery criteria
- Perceived disconnects between courseware content and course learning objectives
- Tendency for both students and instructors to take shortcuts wherever the system allowed them

Scaling of NGCC Courseware

All of the NGCC grantees had prior product users who could be leveraged as a source of potential adoptions for their refined or new products being developed with NGCC funding. The grant terms challenged grantees to go much further, however, to attract enough new adopters to have over 150,000 cumulative student users by the end of 2017. Moreover, the foundation was clear that it wanted to see large numbers of low-income and under-represented minority students experiencing the NGCC products. SRI compiled course section enrollment data provided by NGCC grantees on a semiannual basis between spring 2015 and fall 2017. Use of the NGCC products by postsecondary institutions, instructors, and students over the course of the grant term, as tabulated by SRI, is shown in Tables 1-4 and Figure 1. It should be noted that some of the NGCC products had additional users not included in the tables and figure presented here because supporting use information (institution, course title, instructor name, term) was not sent to SRI.

Table 1. Number of Institutions Participating in NGCC, by Sector

	Public 4-year	Public 2-year	Private 4-year	Online 4-year	Total
Acrobatiq	9	10	11	2	32
Cerego	8	3	1	-	12
CogBooks	2	-	-	-	2
Lumen Learning	3	7	-	1	11
OpenStax	104	137	77	1	319
Smart Sparrow	7	16	2	-	25
Stanford	31	39	24	1	95
TOTAL[a]	**147**	**192**	**107**	**3**	

Note: Online designates colleges offering all programs online.

a Total number of unique institutions; columns will not add to Total in cases where the same institution implemented products from multiple grantees.

Table 2. Number of Instructors Participating in NGCC, by Sector

	Public 4-year	Public 2-year	Private 4-year	Online 4-year	Total
Acrobatiq	22	35	37	13	107
Cerego	15	6	8	-	29
CogBooks	16	-	-	-	16
Lumen Learning	32	44	-	42	118
OpenStax	135	190	88	3	416
Smart Sparrow	20	35	5	-	60
Stanford	71	165	53	6	295
TOTAL[a]	**303**	**455**	**185**	**62**	

Note: Online designates colleges offering all programs online.

[a] *Total number of unique institutions; columns will not add to Total in cases where the same institution implemented products from multiple grantees.*

As can be seen in Table 3, the total documented enrollment in NGCC courses during the timeframe of the grants was just under 140,000. To ascertain the number of low-income students experiencing NGCC courseware, SRI requested that course enrollment data be disaggregated by student status with respect to eligibility for a Pell grant. This level of detail was not available for many course enrollments, however, and the numbers of Pell students shown in Table 3 in the vast majority of cases are estimates derived by applying the percentage of Pell students in a college as reported to the Integrated Postsecondary Education Data System (IPEDS) of the National Center for Education Statistics to the course enrollment total submitted by a grantee or college. In terms of reaching the intended low-income student audience, an estimated 30% of students in course sections using NGCC courseware were Pell grant recipients.

Table 4 shows the NGCC student enrollment data disaggregated by minority status. In this case, all numbers are estimates based on IPEDS ethnicity percentages, and five higher education institutions that did not report data to IPEDS are excluded from the enrollment totals. Here we see that an estimated 36% of students experiencing the NGCC courseware were from ethnicity groups that historically have been under-represented in higher education.

Table 3. Number of Students Documented as Experiencing NGCC Courseware, 2015-17, by Grantee, Institution Type and Pell Status

Grantee	Public 4-year		Public 2-year		Private 4-year		Online 4-year		Total	
	Pell	Non-Pell	Pell	Non-Pell	Pell	Non-Pell	Pell	Non-Pell	Pell	Non-Pell
Acrobatiq	851	2,540	361	1,188	1,440	2,577	10,766	28,574	13,418	34,879
Cerego[a]	1,105	1,895	53	274	393	525	-	-	1,551	2,694
CogBooks[b]	1,244	1,298	-	-	-	-	-	-	1,244	1,298
Lumen Learning	1,585	1,326	1,751	2,960	-	-	853	1,362	4,189	5,648
OpenStax	4,257	9,926	3,494	9,100	1,401	2,894	4	24	9,156	21,944
Smart Sparrow	1,344	2,080	723	1,183	67	77	-	-	2,134	3,340
Stanford/OLI	3,016	4,908	3,590	13,914	3,093	7,918	110	322	9,809	27,062
TOTAL	**13,402**	**23,973**	**9,972**	**28,619**	**6,394**	**13,991**	**11,733**	**30,282**	**41,501**	**96,865**

Note: Student numbers based on course section- and student-level enrollment data sent to SRI by grantees.

[a] Cerego declined to provide enrollment data for fall 2017.

[b] Except for CogBooks, all Pell values are estimates based on applying 2013-14 IPEDS data on percentage of Pell students to course enrollment data. CogBooks Pell values are based on institutional data (not estimates).

Table 4. Estimated Number of Under-represented Minority and Other Students Experiencing NGCC Courseware, 2015-17, by Grantee and Institution Type

Grantee	Public 4-year		Public 2-year		Private 4-year		Online 4-year		Total	
	URM	Non-URM	URM	Non-URM	URM	Non-URM	URM	Non-URM	URM	Non-URM
Acrobatiq	799	2,592	742	807	2,121	1,836	7,991	29,312	11,653	34,547
Cerego[a]	1,557	1,443	223	104	387	531	-	-	2,167	2,078
CogBooks[b]	1,671	871	-	-	-	-	-	-	1,671	871
Lumen Learning	1,869	1,040	1,847	1,276	-	-	1,185	1,030	4,901	3,346
OpenStax	4,357	9,758	4,509	8,085	1,267	3,028	14	14	10,147	20,885
Smart Sparrow	1,729	1,694	878	1,028	72	72	-	-	2,679	2,794
Stanford/OLI	3,597	4,302	8,937	8,472	2,125	8,884	209	223	14,868	21,881
TOTAL[c]	**15,579**	**21,700**	**17,136**	**19,772**	**5,972**	**14,351**	**9,399**	**30,579**	**48,086**	**86,402**

Note: Student numbers based on course section- and student-level enrollment data sent to SRI by grantees. URM = Under-represented minority (African American, Hispanic, Native American, Pacific Islander).

[a] Cerego declined to provide enrollment data for fall 2017.

[b] Except for CogBooks, all URM values are estimates based on applying 2013-14 IPEDS data on percentage of URM students to course enrollment data. CogBooks Pell values are based on institutional data (not estimates).

[c] Totals do not include enrollments from institutions that implemented NGCC courseware but were not found in IPEDS data.

Scaling Trends

The number of students enrolled in courses using individual grantees' products are shown by academic term in Appendix A. Across the NGCC portfolio, documented student enrollment in course sections using the products increased term-over-term from spring/summer 2015 (when it was 7,745) through spring/summer 2017, when it reached 42,456.

NGCC grantees approached scaling of their products in different ways. Some grantees did much of their scaling by approaching faculty members who had used one of their products in the past. The advantage of leveraging existing relationships in this way was that agreements to adopt the NGCC version of a product could be reached quite quickly. The disadvantage was that each adoption agreement brought only as many students as that particular faculty member taught. Other grantees focused on securing agreements for institution-wide adoption with individuals at higher levels of the college or university (e.g., department chairs or provosts). These agreements were much more laborious to obtain, but had the advantage of bringing along multiple instructors and of being less dependent on any one faculty member.

Table 5 shows the ratio of instructors to institutions for each grantee and market sector.

Table 5. Ratio of Instructors to Institutions Participating in NGCC, by Sector

	Public 4-year	Public 2-year	Private 4-year	Online 4-year	Total
Acrobatiq	2.44	3.50	3.36	6.50	3.34
Cerego	1.88	2.00	8.00	-	2.64
CogBooks	8.00	-	-	-	8.00
Lumen Learning	10.67	6.29	-	42.00	10.73
OpenStax	1.30	1.39	1.39	3.00	1.28
Smart Sparrow	2.86	2.19	2.50	-	2.40
Stanford	2.29	4.23	2.21	6.00	3.11
NGCC Average[a]	**2.06**	**2.37**	**1.73**	**20.67**	**2.24**

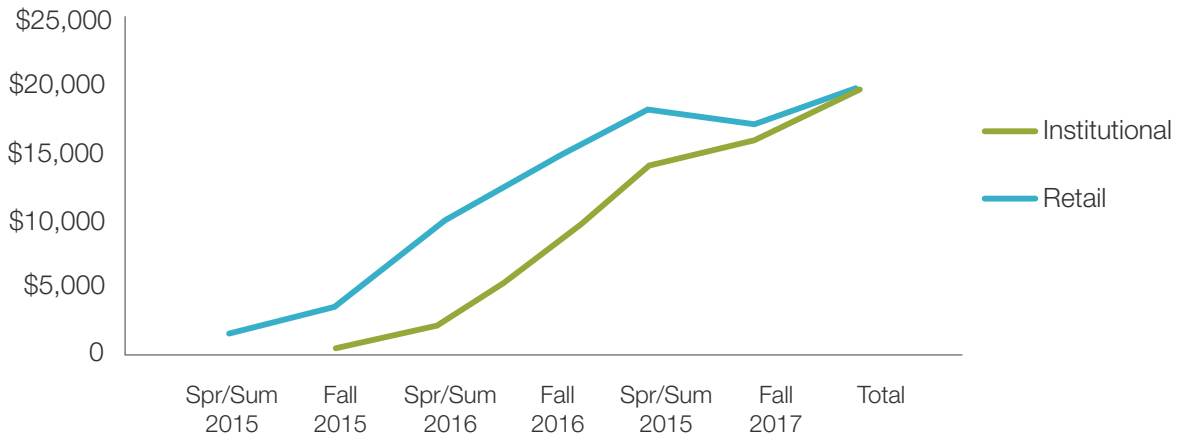
[a] *Each institution's number of unique instructors per institution is equally weighted in the row Total and NGCC Average.*

The sector breakdown of data on instructors per institution suggest that **online institutions are more likely than others to adopt courseware on an institutional level.** The smallest instructor:institution ratios were found for 4-year private colleges. Among public institutions, **two-year colleges appear to be doing somewhat broader adoptions than four-year colleges are, but the difference is not large.**

Next, we categorized the NGCC grantees' scaling efforts as primarily "retail" (going through individual faculty members) or "institutional" adoption approaches, based on the ratio of instructors per institution and information gleaned from communications with grantee staff. This classification resulted in a fairly even split of the grantees with three classified as pursuing institutional adoptions as their primary scaling strategy and four classified as using primarily a "retail" scaling approach. We then computed the average cumulative number of students using the courseware for each term for each of the scaling strategy groups. The results are shown in Figure 1.

Based on the experience of the NGCC grantees, efforts to scale courseware to higher education institutions can start faster by reaching out directly to individual faculty members. The fact that a number of the grantee organizations had an existing individual customer base for earlier products no doubt made this easier. Institutional adoptions require more effort, and **it was only in the latter portion of the grant period that institutional adoption strategies started to show a steeper growth rate.** It should be noted also that there are other advantages to promoting courseware at the institutional rather than individual faculty member level, as will be discussed later in this report.

Figure 1. Average cumulative number of NGCC courseware users by scaling strategy



Issues in Courseware Implementation

Many implementation issues were uncovered during the courseware pilot phase and through conversations with instructors who were early adopters. Others came out during researchers' visits to implementing classrooms using pilot versions of the software and from instructor responses on the instructor Survey. Information from these various sources is synthesized and summarized below.

- In some cases, instructors and/or students wanted more guidance on how to use the courseware before starting to work with it.
- **Usability issues were not uncommon but were generally not severe enough to curtail courseware use.** The most commonly reported issues were problems logging into the courseware, incompatibilities with existing computer hardware or software, and confusing dashboards or system interfaces.
- **Many students did not use courseware-embedded review functions as intended.** One grantee found, for example, that their system's recommendations for adaptive practice were ignored by nearly 40% of their beta product student users. Another had system log data showing that practice modules at the end of their electronic book chapters were skipped by many students. On the instructor survey, 39% of NGCC instructors reported students using the courseware in an unintended manner, such as exploiting features of the system rather than learning the material, as an implementation barrier.
- **Instructors did not always leverage all of the courseware's capabilities.** For example, one grantee's system log data showed that during their pilot testing only 7% of the messages their system recommended that instructors send to students actually got sent.
- **Using courseware products on mobile devices can limit use of interactive media or ability to work on complex problems.** Plans for embedding some of these features in versions for mobile platforms were dropped because of usability issues.
- **Some instructors want the capability to modify the courseware.** Alignment between courseware content and course objectives appeared to concern some instructors. This is a potential issue for any higher education learning technology that incorporates academic content. Instructors also wanted to be able to modify courseware mastery criteria and pacing that they felt were inappropriate for their students.

NGCC Courseware Outcomes for Students

We conducted a series of analyses to estimate the potential impacts of the courseware products involved in NGCC on student course outcomes. While SRI and the grantees collaborated in creating impact research plans, ultimately the impact study research designs were limited to protocols that institutions and their instructors were willing to enact. None of the higher education institutions viewed randomly assigning either students or instructors to courseware and business-as-usual course sections as feasible given their standard practices for course enrollment. To the extent possible, SRI controlled for differences in student characteristics that might affect course outcomes in conducting an impact analysis for each combination of grantee, institution, course, and academic term of courseware use (e.g., use of Grantee A's courseware in Biology 101 at Creative College in fall 2016). Each of these combinations is referred to as an "implementation dataset" in the discussions that follow.

All the implementation datasets submitted by higher education institutions and grantees were screened for quality prior to conducting an impact analysis. The criteria for including a dataset in the NGCC impact analyses were:

- submission of data for both a treatment (courseware-using) and a comparison group;
- common end-of-course outcome measure;
- common prior achievement or pretest measure for both treatment and comparison students (usually student's cumulative college GPA was submitted);
- at least 30 students in each of the treatment and comparison groups; and

- baseline equivalence (not more than .25 standard deviation difference between treatment and comparison students on any student characteristic or pretest measure).

SRI requested the following student-level variables in the datasets for impact analysis: gender, race/ethnicity, Pell status, age, first-generation college goer, enrollment status (full- or part-time), cumulative college GPA, prior attempts in this course, and prior achievement measure (such as a math placement test). Those student-level variables reported for most students were used in the analytic model applied to a dataset. Very few datasets included adequate data on a prior achievement measure other than cumulative college GPA. We encouraged grantees to work with the higher education partners to set up impact studies using a common end-of-course assessment across treatment and comparison groups. This actually happened in fewer than five cases, however. As external organizations, the NGCC grantees did not have the degree of influence needed to persuade academic departments to change their practices with respect to letting individual faculty choose how to assess learning. For this reason, we used course grade as the common outcome measure for almost all datasets.

Initially, we attempted to obtain both initial enrollment figures and the final enrollment after the course drop deadline for each course section to enable calculations of attrition rates so they could be compared for treatment and comparison conditions. After the first few terms, however, this request was dropped because of the very low rate of reporting compliance and the burden this request placed on higher education institutions.

In many cases, a course was taught using the NGCC product in some course sections and without the product in other sections during the same academic term (concurrent implementation). In other cases, the comparison data for the course taught without the NGCC courseware came from prior terms (historical data) or from one prior or following academic term (lagged comparison).

In all, NGCC grantees and the higher institutions working with them submitted 77 implementation datasets to SRI. In addition to resolving any issues with data labelling or missing data, SRI analysts performed a first review to check for any intractable problems with the research design. Of the datasets submitted to SRI, 8 had to be eliminated because of a serious confound in the study design (e.g., the courseware condition was at one college while the comparison data came from one or more different institutions or one condition had a course term twice as long as that of the other condition). Education technology companies, especially those in "start-up" mode, typically lack the internal research expertise to guide higher education institutions in setting up good study designs, and as noted earlier, they often lack the clout to enforce strong designs even when they are confident about what needs to be done. Another 32 implementation datasets had to be eliminated because of inadequate sample size, and 9 were eliminated because of a lack of baseline equivalency.[19]

A kind of confounding running throughout the datasets to various degrees was that between treatment condition and course section instructors. Particularly when the courseware and comparison sections were both run during the same academic term, instructors did not want to be teaching different sections in different ways so the two conditions usually had different instructors. Although we could not eliminate this confounding, we did document the extent to which instructors in the two conditions were the same, partially overlapping, or completely different so that we could analyze this study design feature as a potential moderator of courseware impacts (as will be discussed below).

After screening, we had a total of 28 NGCC impact study datasets for analysis and synthesis. Table 6, below, shows the demographic characteristics of the students in these impact study data sets overall and by college type. Because some of the studies used multiple prior cohorts to estimate the historical average performance for the course, there were more students in the comparison condition than in the treatment condition that experienced the NGCC courseware. In both conditions, more than half of the students whose data were used in impact analyses were drawn from under-represented minorities and over 35% were Pell grant students. Across all the impact studies with Pell status data, a somewhat higher proportion of students in the treatment condition than in the comparison condition were Pell students (45% versus 36%).

19 The baseline equivalency standard applied in the evaluation was that recommended by the What Works Clearinghouse (students in the conditions being compared varying by no more than .25 standard deviation). There was one additional case where the baseline equivalence test was failed, but the dataset was large enough that we could use the subset of data for full-time students in the course, which met both the sample size and the baseline equivalence criteria.

Table 6. Inclusion of Pell and under-represented minority students in NGCC impact study datasets, by institution type

IHE Type	Treatment Sections					Comparison Sections				
	All	Pell		URM		All	Pell		URM	
		Number	Percent	Number	Percent		Number	Percent	Number	Percent
Public 2-year	1,521	674	44%	831	55%	3,446	1,601	46%	1,738	50%
Public 4-year	2,947	1,515	51%	1,908	65%	5,010	2,507	50%	2,902	58%
Private 4-year	457	255	56%	195	43%	499	269	54%	213	43%
Online 4-year	3,041	~712	~34%	1,596	52%	6,108	~1,109	~37%	4,009	66%
TOTAL[a]	**7,966**	**~3,156**	**~40%**	**4,530**	**57%**	**15,063**	**~5,486**	**~36%**	**8,862**	**59%**

Note: URM = Under-represented minority

[a] Does not include data from institutions that could not identify Pell students.

Because of the differences among NGCC products and the institutions that adopted them, we chose to produce impact estimates for individual datasets and then to use a meta-analytic approach to summarize findings across datasets rather than putting all the data in a single analysis. Meta-analysis is useful as a systematic, quantitative technique for combining data across similar studies to obtain a single impact estimate with greater statistical precision than any one of the studies provides. Because it is based on multiple studies with greater diversity among participants, a meta-analysis can better support extrapolation to the general population. It is also useful in exploring factors that influence the size of the impact in different implementations.

Table 7 shows the mean completion rate for treatment and comparison course sections prior to adjustment for differences in student characteristics for the 28 datasets. We attempted to run impact analyses correcting for differences in student characteristics for these course completion data (dichotomized as 1 = completed and 0 = did not complete). However, because of the small amount of variation in this outcome (as most students complete the course successfully), the statistical model was a poor fit to the data, prompting us to rely on analyses of course grades to estimate courseware impacts.

Table 7. Unadjusted Completion Rates for Courses in NGCC, by Grantee and IHE Type

Grantee	IHE Type	Course/ Department	Course Type	Modality Contrast	Treatment Completion Rate[a]	Comparison Completion Rate[a]
Acrobatiq	Online 4-yr	Intro to Psychology/ Psychology	Gateway	Online vs online	.64	.52
Cerego	Private 4-yr	Macroeconomics/ Economics	Gen Ed.	Online vs online	.84	.90
CogBooks	Public 4-yr	The Living World/ Biology	Gen Ed.	Blended/ hybrid vs F2F	.85	.77
CogBooks	Public 4-yr	General Biology/ Biology	Gen Ed.	Blended/ hybrid vs F2F	.51	.37
CogBooks	Public 4-yr	General Biology/ Biology	Gen Ed.	Blended/ hybrid vs F2F	.53	.39
CogBooks Average[b]					***.63***	***.51***
Lumen	Online 4-yr	Principles of Marketing/ Business	Gateway	Online vs online	.87	.83
Lumen	Online 4-yr	Intro to Business/ Business	Gen Ed.	Online vs online	.80	.84
Lumen	Online 4-yr	Principles of Macroeconomics/ Economics	Gen Ed.	Online vs online	.84	.86
Lumen	Online 4-yr	Principles of Microeconomics/ Economics	Gateway	Online vs online	.78	.87
Lumen	Public 2-yr	Intro to Business/ Business	Gateway	Online vs online	.71	.64
Lumen	Public 2-yr	Macroeconomic Principles/ Economics	Gen Ed.	Blended/ hybrid vs F2F	.59	.61
Lumen	Public 4-yr	Intro to Business/ Business	Gen Ed.	Blended/ hybrid vs F2F	.93	.90
Lumen	Public 4-yr	Intro to Microeconomics/ Economics	Gateway	Blended/ hybrid vs F2F	.82	.73
Lumen	Public 4-yr	Principles of Marketing/Business	Gateway	Blended/ hybrid vs F2F	.91	.91
Lumen	Public 2-yr	Intro to Business/ Business	Gateway	Blended/ hybrid vs F2F	.69	.60
Lumen	Public 2-yr	Principles of Macroeconomics/ Economics	Gen Ed.	Blended/ hybrid vs F2F	.60	.72

a Completion rates do not control for other predictors of student success, such as prior academic achievement. Completion rates should therefore be interpreted cautiously. We did not perform statistical tests for uncontrolled completion rates due to interpretation concerns. See Table 8 for impact estimates that include statistical controls for prior achievement and other predictors of student success.

b Grantee averages are weighted such that each course at each institution counts equally regardless of the number of students or sections.

Table 7. Unadjusted Completion Rates for Courses in NGCC, by Grantee and IHE Type, (cont'd.)

Grantee	IHE Type	Course/ Department	Course Type	Modality Contrast	Treatment Completion Rate[a]	Comparison Completion Rate[a]
Lumen	Public 2-yr	Principles of Microeconomics/ Economics	Gateway	Blended/ hybrid vs F2F	.66	.72
Lumen	Online 4-yr	Marketing Principles/ Business	Gateway	Online vs online	.74	.77
Lumen	Online 4-yr	Intro to Business and Management/ Business	Gateway	Online vs online	.70	.61
Lumen	Online 4-yr	Principles of Macroeconomics/ Economics	Gen Ed.	Online vs online	.86	.20
Lumen	Online 4-yr	Principles of Microeconomics/ Economics	Gateway	Online vs online	.78	.86
Lumen Average[b]					***.77***	***.73***
Smart Sparrow	Public 4-yr	The Living World/ Biology	Gen Ed.	Blended/ hybrid vs F2F	.83	.83
Smart Sparrow	Public 2-yr	Principles of Biology/ Biology	Gen Ed.	Blended/ hybrid vs F2F	.60	.71
Smart Sparrow	Public 4-yr	General Education Biology/ Biology	Gen Ed.	Blended/ hybrid vs F2F	.80	.74
Smart Sparrow	Public 2-yr	Biology Concepts/ Biology	Gen Ed.	Blended/ hybrid vs F2F	.79	.75
Smart Sparrow	Private 4-yr	Survey of Bioscience/ Biology	Gen Ed.	Blended/ hybrid vs F2F	.85	.88
Smart Sparrow Average[b]					***.77***	***.78***
Stanford/ OLI	Public 2-yr	Intro Statistics/ Mathematics & Statistics	Gateway	Blended/ hybrid vs F2F	.84	.72
Stanford/ OLI	Online 4-yr	Intro to Statistics/ Mathematics & Statistics	Gateway	Online vs online	.77	.69
Stanford/ OLI Average[b]					.81	.71
NGC Overall Average					***.75***	***.74***

a Completion rates do not control for other predictors of student success, such as prior academic achievement. Completion rates should therefore be interpreted cautiously. We did not perform statistical tests for uncontrolled completion rates due to interpretation concerns. See Table 8 for impact estimates that include statistical controls for prior achievement and other predictors of student success.

b Grantee averages are weighted such that each course at each institution counts equally regardless of the number of students or sections.

Figure 2 shows the effect size for each of the implementation datasets in our analysis, and Table 8 provides the statistical details for the 28 impact estimates. In 10 of the 28 datasets, students using the NGCC courseware earned significantly higher grades than those in the business-as-usual versions of the course. In 4 implementations, students in the business-as-usual version of the course earned higher grades. In the other half of the datasets, student grades in the two conditions were equivalent after controlling for differences in student characteristics.

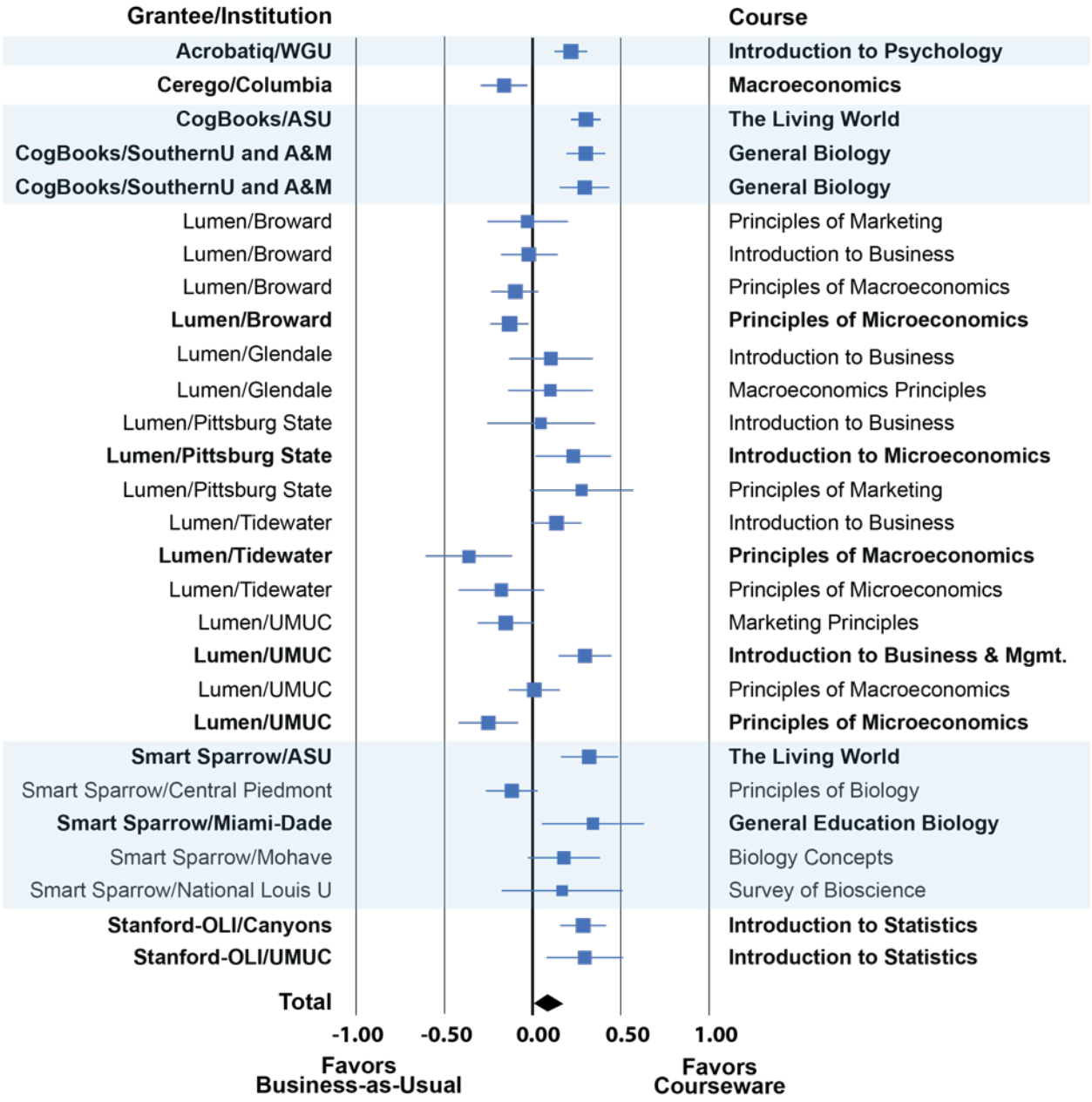
Interpreting Effect Sizes

For each courseware impact study, analysts first used a statistical model (ordinary least squares regression) to control for any differences between courseware-using students and those in the comparison course sections in terms of prior achievement and other characteristics potentially related to course outcomes (such as ethnicity or enrollment as a full-time or part-time student). Using the corrected course grades generated by the statistical model, analysts then computed an *effect size*. Effect sizes in these analyses are the difference between the treatment and the comparison group model-adjusted means for course grade expressed in standard deviation units. (See Appendix C for more information about the statistical modelling.) An effect size with a + sign means that grades were higher for the courseware-using students; an effect size with a -sign means that students in comparison course sections had higher grades.

When testing the hypothesis that the two course section types differed in terms of course grades, it is important to keep in mind that we are working with a sample that represents a larger population of interest (here, the population of all students at a particular college taking the designated course implemented with courseware versus the population taking the same course at the same institution without courseware). To control for the risk of concluding that there is a difference between coursewareusing students and other students when there really is not, analysts set a criterion or level for the acceptable rick of concluding there is a difference based on outcomes for the samples in the study when there really is not one for the populations from which the samples were drawn. The graphs that follow use the conventional standard for statistical significance of having less than a 1 in 20 chance of concluding that two means are different when the underlying populations are equivalent ($p < .05$). Some tables later on in the report also indicate which impact estimates meet more stringent standards such as only a 1 in 100 chance of a false positive conclusion ($p < .01$) or a 1 in 1,000 chance ($p < .001$).

Statistically significant impact estimates are shown in boldface in the graphs that follow. For those impact estimates that are not shown in boldface, we cannot be confident that the observed difference in course grades is not attributable to chance. *Note that the lack of a statistically significant difference does not mean that we can be confident that there is no difference. Additional studies are needed to address the uncertainty in these cases.*

Figure 2. NGCC Courseware Impact Study Effect Estimates



The square for each courseware implementation represents the estimated impact (effect size). The size of the square represents the weighting of the study in the meta-analysis. The length of the horizontal line through the square represents the confidence interval around the impact estimate. The longer the line, the more uncertainty there is around the true impact of the courseware implementation. The diamond at the bottom of the graph represents the average effect for the 28 courseware implementations. Its width represents the 95% confidence interval for the average impact.

Squares to the right of the boldface vertical line represent studies in which students in the courseware sections outperformed students in the business-as-usual sections. Squares to the left of the boldface vertical line represent studies in which students in the business-as-usual courseware sections outperformed students in the courseware sections. Only those courseware implementations with boldface labels are statistically significant (i.e., we can be confident that the difference in average grades for students in courseware and business-as-usual course sections did not occur by chance). In courseware implementations that do not have boldface labels, we cannot rule out the possibility that the observed difference in courseware and business-as-usual section average grades was attributable to chance.

Table 8. Impact Estimates for 28 NGCC Impact Studies

Grantee	IHE/Course	Treatment Sample for Analysis[a]	Effect Size (g)[b]	Standard Error	Lower Limit	Upper Limit	Z-value
Acrobatiq	WGU Intro to Psychology	1,071	**+0.221*** **	0.049	+0.124	+0.318	4.467
Cerego	Columbia Macroeconomics	396	**-0.161***	0.070	-0.298	-0.025	-2.315
CogBooks	ASU The Living World	1,259	**+0.306*** **	0.044	+0.220	+0.392	6.977
CogBooks	Southern U and A&M General Biology 104	448	**+0.306*** **	0.057	+0.194	0.418+	5.345
CogBooks	Southern U and A&M General Biology 105	522	**+0.300*** **	0.074	+0.155	+0.444	4.073
CogBooks Aggregate Impact[c]		***2,229***	***+0.305****	***0.031***	***+0.243***	***+0.367***	***9.686***
Lumen	Broward Intro to Marketing	109	-0.023	0.118	-0.255	+0.208	-0.198
Lumen	Broward Intro to Business	241	-0.015	0.084	-0.180	+0.149	-0.184
Lumen	Broward Principles of Macroeconomics	257	-0.095	0.070	-0.233	+0.043	-1.354
Lumen	Broward Principles of Microeconomics	365	**-0.126***	0.058	-0.239	-0.012	-2.174
Lumen	Glendale Intro to Business	90	+0.109	0.123	-0.132	+0.350	0.884
Lumen	Glendale Macroeconomic Principles	79	+0.105	0.125	-0.139	+0.350	0.843
Lumen	Pittsburg State Intro to Business	55	+0.050	0.158	-0.259	+0.359	0.316
Lumen	Pittsburg State Intro to Microeconomics	146	**+0.235***	0.112	+0.016	+0.454	2.105
Lumen	Pittsburg State Principles of Marketing	58	+0.284	0.152	-0.013	+0.581	1.872
Lumen	Tidewater Intro to Business	271	+0.139	0.075	-0.007	+0.285	1.860
Lumen	Tidewater Principles of Macroeconomics	70	**-0.358** **	0.126	-0.606	-0.110	-2.832
Lumen	Tidewater Principles of Microeconomics	75	-0.181	0.126	-0.427	+0.065	-1.441
Lumen	UMUC Principles of Marketing	190	-0.148	0.084	-0.313	+0.016	-1.764

a Some enrolled students could not be included in the analysis because their records were missing key data elements.

b Bold numbers in column 4 indicate statistically significant differences.

c Datasets are weighted equally in computing product average values.

**p = < 0.05; **p = < 0.01; ***p = 0.001*

Table 8. Impact Estimates for 28 NGCC Impact Studies, (cont'd.)

Grantee	IHE/Course	Treatment Sample for Analysis[a]	Effect Size (g)[b]	Standard Error	Lower Limit	Upper Limit	Z-value
Lumen	UMUC Intro to Business and Management	291	**0.300*** **	0.078	+0.148	+0.452	3.871
Lumen	UMUC Principles of Macroeconomics	241	+0.014	0.076	-0.135	+0.162	0.178
Lumen	UMUC Principles of Microeconomics	182	**-0.247** **	0.087	-0.418	-0.076	-2.828
Lumen Aggregate Impact[c]		***2,720***	***-0.002***	***0.046***	***-0.092***	***0.087***	***-0.049***
Smart Sparrow	ASU The Living World	150	**+0.325*** **	0.084	+0.160	+0.489	3.871
Smart Sparrow	Central Piedmont Principles of Biology	334	-0.115	0.076	-0.263	+0.034	-1.509
Smart Sparrow	Miami-Dade General Education Biology	309	+0.346*	0.149	+0.055	+0.638	2.327
Smart Sparrow	Mohave Biology Concepts	104	+0.181	0.106	-0.028	+0.390	1.699
Smart Sparrow	National Louis University Survey of Bioscience	61	+0.172	0.176	-0.174	+0.517	0.975
Smart Sparrow Aggregate Impact[c]		***958***	***+0.172***	***0.104***	***-0.032***	***+0.375***	***1.652***
Stanford/ OLI	College of Canyons Introductory Statistics	498	**+0.291*** **	0.069	+0.156	+0.426	4.235
Stanford/ OLI	UMUC Intro to Statistics	94	**+0.299** **	0.111	+0.082	+0.516	2.704
Stanford/ OLI Aggregate Impactc		***592***	***+0.293****	***0.058***	***+0.179***	***+0.408***	***5.025***

a Some enrolled students could not be included in the analysis because their records were missing key data elements.

b Bold numbers in column 4 indicate statistically significant differences.

c Datasets are weighted equally in computing product average values.

**p = < 0.05; **p = < 0.01; ***p = 0.001*

The average effect size of +.09 means that **on average, the grades earned by students in course sections using NGCC courseware were slightly (and statistically significantly) better than the grades earned by students in sections without the software.** An effect size of 0.09 is equivalent to an improvement index of 4. This means that (on average, controlling for what we can control for) a 50th-percentile student in the course taught as usual would be predicted to improve to a 54th-percentile student through the use of the NGCC courseware. This average improvement is very modest, but it is clear from Figure 2 that there was great variability across the datasets, sometimes even

for the same product and institution (see, for example, UMUC results with Lumen Learning). Such variability points to the need to look more deeply into the conditions and practices associated with more and less favorable outcomes for courseware use.

This variability in impacts is consistent with the interpretation that efficacy is not a quality that resides in a piece of courseware per se. Rather, **efficacy results from a particular set of instructional practices as they play out in a particular context and with particular kinds of students** (Means, Murphy, & Shear, 2017). Impact estimates will also be influenced by the nature of the instruction in the business-as-usual course sections to which courseware-using sections are compared. The variability in impacts for these 28 courseware implementations provide a resource for investigating the conditions and practices associated with more and less positive student outcomes.

What student characteristics are associated with better courseware outcomes?

Next, we conducted exploratory analyses to examine the relationship between NGCC courseware outcomes and a set of student characteristics that have been associated with differential course performance in prior research. Table 9 below shows the number of impact study datasets that included sufficient numbers of students with data on a characteristic to enable us to examine the influence of that characteristic in our statistical model, and the proportion of datasets including that characteristic for which it was associated with differences in treatment group learning outcomes.

The analysis of relationships between student characteristics and NGCC courseware impacts in the 28 datasets found that:

- Prior GPA is a strong and consistent predictor of grade in courseware-using sections.

Table 9. Student Characteristics Associated with Courseware Outcomes

Student Characteristics	Percent of Studies Where Significantly Associated with Treatment Outcomes	Number of Datasets with the Data Element
Cumulative college GPA	96%	26
Attempted course previously	53%	15
Under-represented minority	42%	26
Pell grant	23%	22
Age	12%	26
Gender	11%	28
Enrollment status (full- v. part-time)	8%	24
First-generation college goer	8%	13

- Students who had attempted the course previously and failed to earn a credit had lower grades in the majority of the impact analyses with this variable in the dataset.
- Under-represented students experienced different courseware impacts compared to other students in around two-fifths of the studies, meaning that in the majority of analyses, courseware impacts were equivalent for different ethnic groups.
- There was no difference between impacts for Pell and for non-Pell students in three-quarters of the studies. Pell students had different outcomes than non-Pell students did in the courseware-using condition in just under a quarter of the studies, but the direction of the difference was for Pell students to have better grades as often as it was for them to have lower grades.
- Relatively few studies (less than 1 out of 8) found associations between age, gender, enrollment status, or first-generation college status and courseware outcomes.

In general, once prior achievement (as measured here by prior GPA) is controlled for, courseware outcomes appear to be similar for students of different ages, genders, and status as full- or part-time students. The only student characteristics that appear to influence courseware outcomes after controlling for prior achievement are ethnicity and a prior attempt in the course with a D/F/W outcome.

Under what circumstances are NGCC products effective?

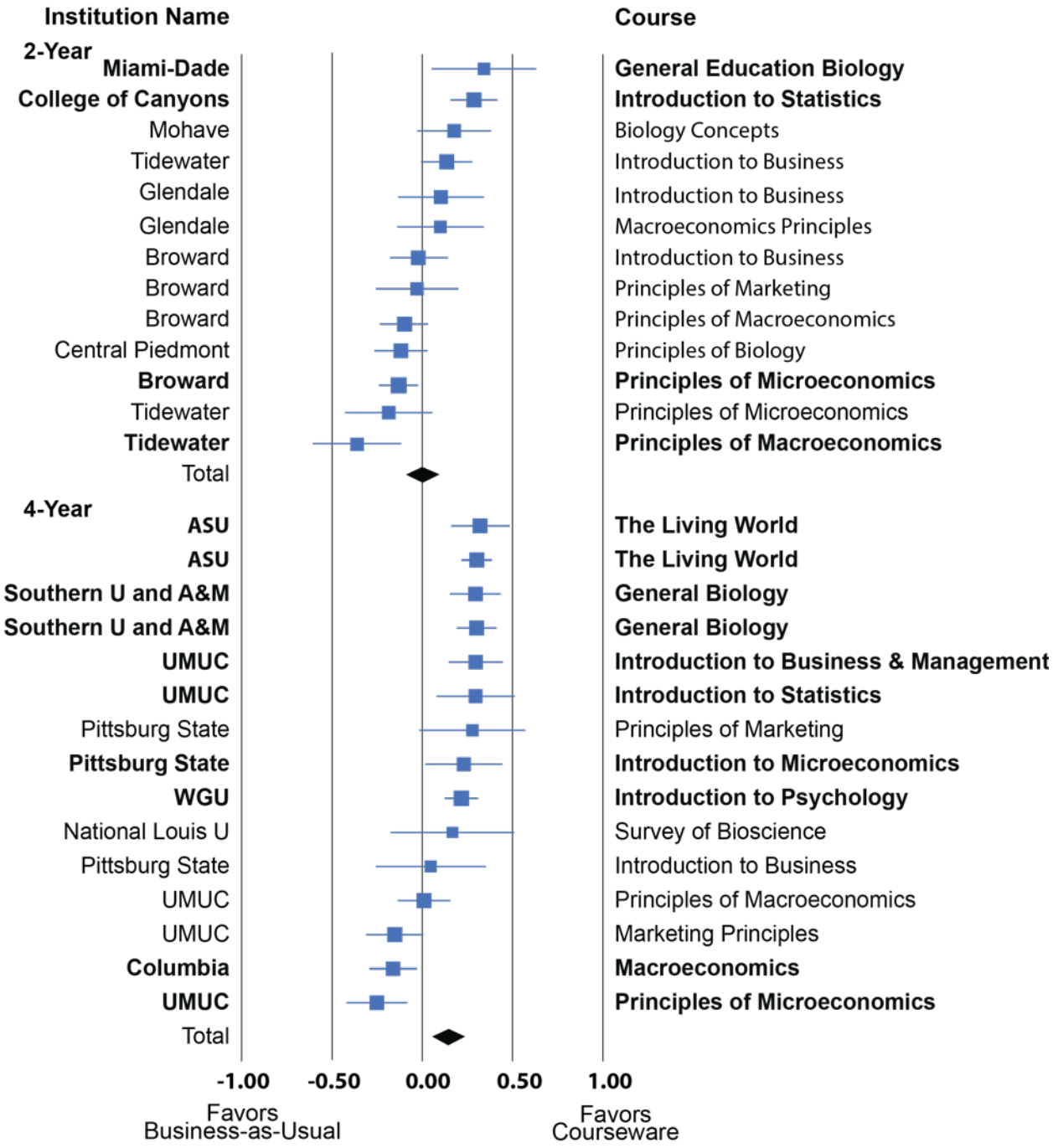
To gain insight into the circumstances that promote effective use of courseware and stronger evidence of efficacy, we coded each impact study for the conditions under which the courseware was used. Coded features included:

- Type of IHE (2-year versus 4-year college)
- Course subject area (e.g., statistics, economics)
- Treatment-comparison modality contrast (i.e., blended/online v. face to face; fully online with courseware v. fully online without courseware)
- Class size
- Instructor volunteer status
- Type of instructor (faculty versus instructor or adjunct)
- Instructor employment status (full- versus part-time)

We then tested each of these conditions to determine whether it was associated with the magnitude of the impact of using courseware. Five of these variables (IHE type, course subject area, modality contrast, class size, and instructor employment status) were statistically significant moderators of NGCC courseware impacts on student grades.

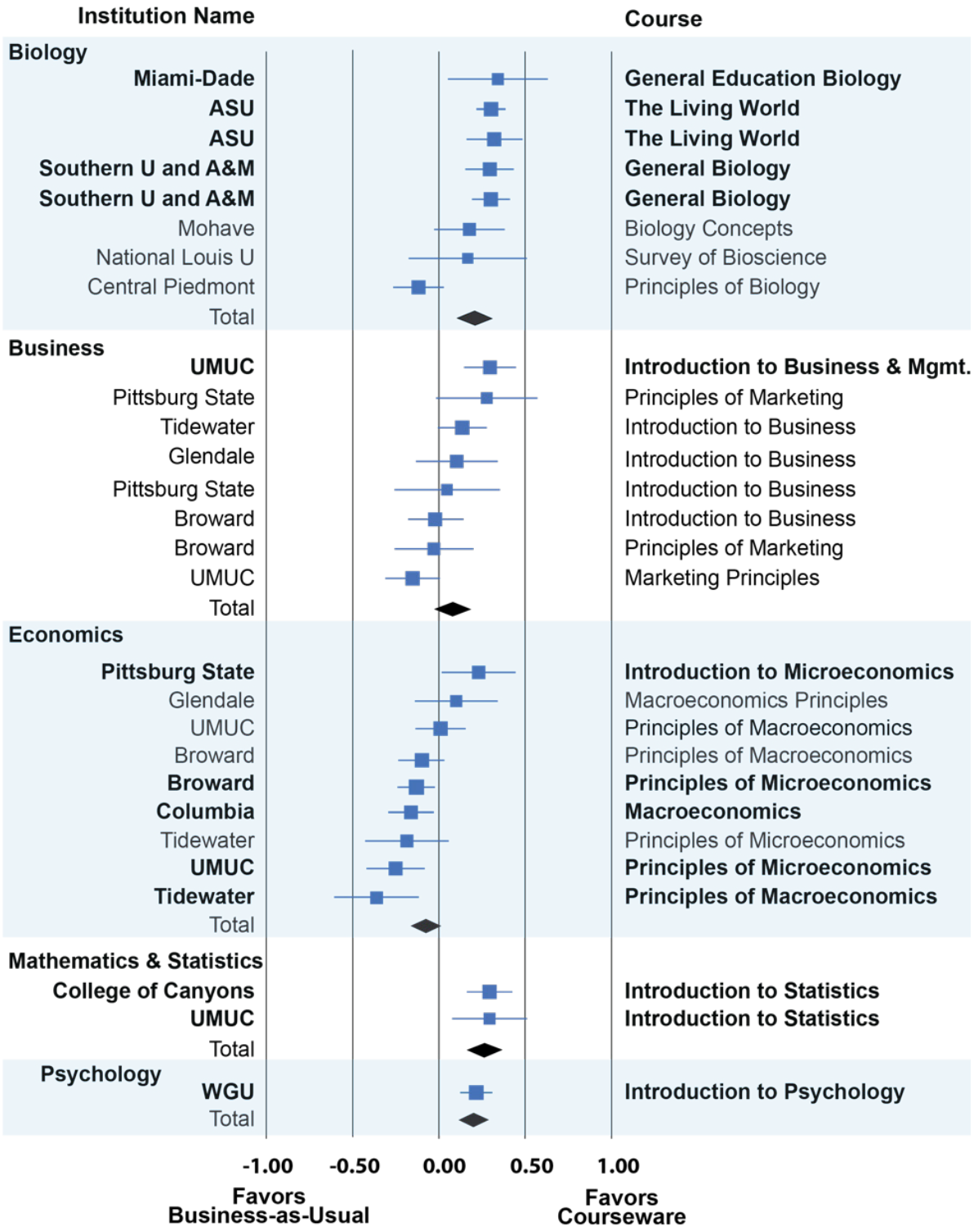
Figure 3 shows effect sizes grouped by whether the implementation was in a 2-year or a 4-year college. **The average courseware impact estimate was significantly positive for implementations in 4-year colleges and statistically insignificant in 2-year colleges.** This finding suggests the need to better understand differences in instructor practices around courseware use in these two kinds of institutions, especially given the importance of community colleges as access points for postsecondary education for low-income and under-represented minority students. However, it should be noted that there were only a dozen impact studies conducted in community colleges and that most of them involved the product of a single NGCC grantee. Finding community college partners with the organizational capacity to implement adaptive courseware and mount credible studies of of its impacts was a challenge for the NGCC grantees.

Figure 3. Impact Study Effect Estimates by Institution Type



Boldface indicates that the impact estimate is statistically significant (i.e., we can be confident that the difference in average grades for students in courseware and business-as-usual course sections did not occur by chance). In courseware implementations that are not in boldface, we cannot rule out the possibility that the observed difference in courseware and business-as-usual section average grades was attributable to chance.

Figure 4. Impact Study Effect Estimates by Course Subject Area



Boldface indicates that the impact estimate is statistically significant (i.e., we can be confident that the difference in average grades for students in courseware and business-as-usual course sections did not occur by chance). In courseware implementations that are not in boldface, we cannot rule out the possibility that the observed difference in courseware and business-as-usual section average grades was attributable to chance.

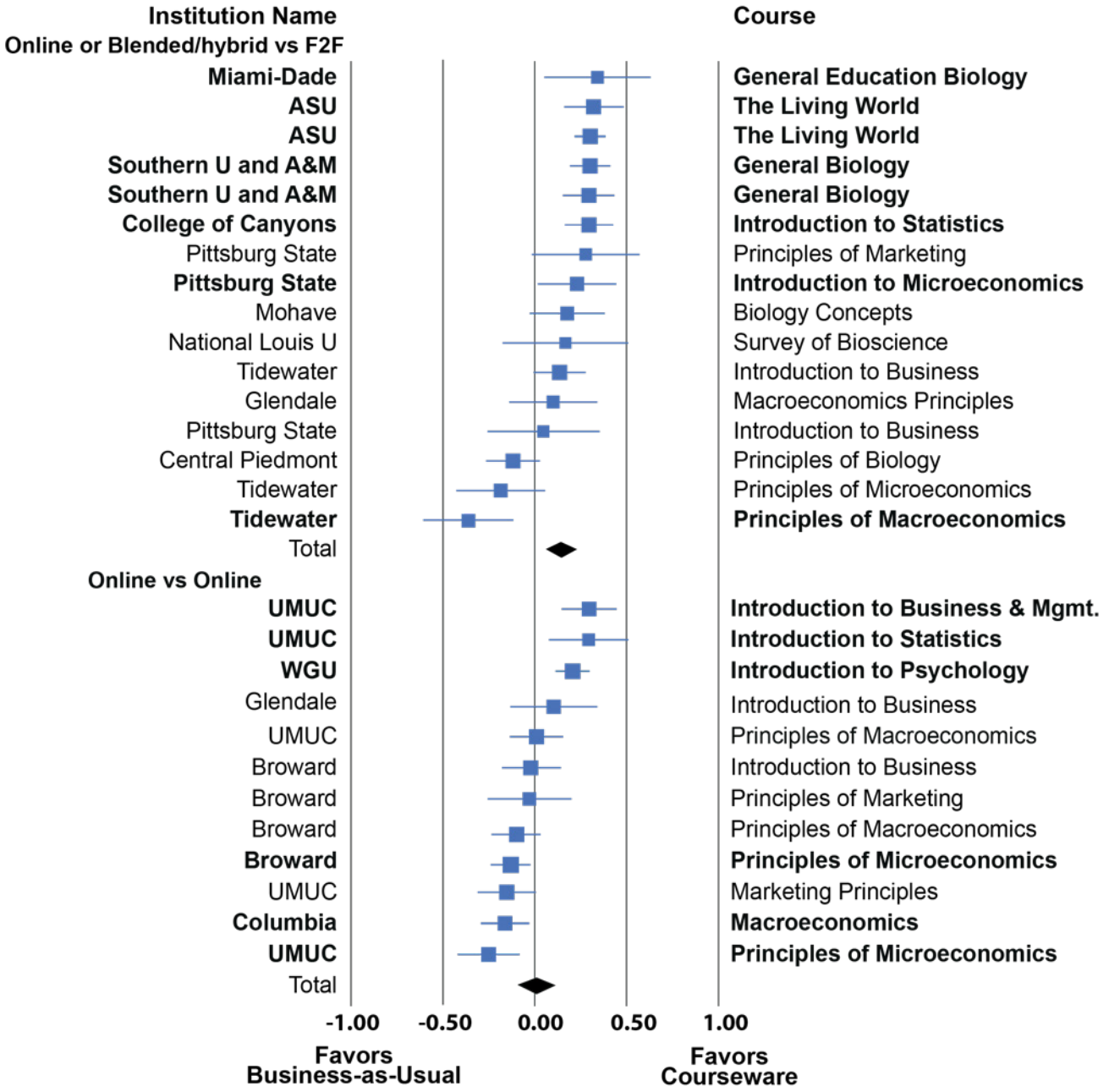
In terms of course subject area, the 28 impact studies dealt with five different academic disciplines: biology, business administration, economics, mathematics/statistics, and psychology. Figure 4 shows the impact estimates organized by course subject. On average, the **implementations of courseware in biology, psychology, and math/statistics classes led to higher student course grades than those earned in business-as-usual classes.** In contrast, on average the courseware impact appeared to be insignificant for business administration and economics classes. This finding is consistent with a prior meta-analysis finding stronger benefits for blended learning in STEM (science, technology, engineering, and mathematics) classes than in other subject areas (Vo, Zhu, & Diep, 2017). However, it should be remembered that there were just a few products or even only a single courseware product for each subject area.

The NGCC courseware implementations varied in terms of whether the courseware was incorporated into a course taught primarily in a face-to-face mode, using some blend of face-to-face and online elements, or was entirely online. In addition, the comparison course sections to which the courseware-using sections were compared varied in terms of whether they were taught online or face-to-face. Among the impact studies, 12 contrasted two online versions of the course (one with the NGCC courseware and one without), and the others used blended or in one case, online instruction in the treatment condition, and instruction that was primarily face-to-face in the comparison condition. Figure 5 illustrates the variation in estimated courseware impacts for these different modality comparisons.

Only those impact studies in which the course modality varied between treatment and comparison groups (i.e., blended/online vs. face-to-face) produced a significantly positive impact on average. This is congruent with findings reported in a larger meta-analysis performed for the U.S. Department of Education (Means et al., 2010) and reported in the earlier study of adaptive courseware by Yarnall, Means, and Wetzel (2016). It appears that the best prospects for improving student outcomes are associated with moving from a traditional face-to-face format to a blended learning approach promoting more active learning on the part of students. In the NGCC studies it was not possible to disentangle the impact of the NGCC courseware per se from that of the shift in instructional modality. From the standpoint of educators, however, identifying a strategy for improving outcomes (combining courseware with face-to-face instruction) is important even if we cannot quantify the extent to which the courseware itself is responsible for observed improvements.

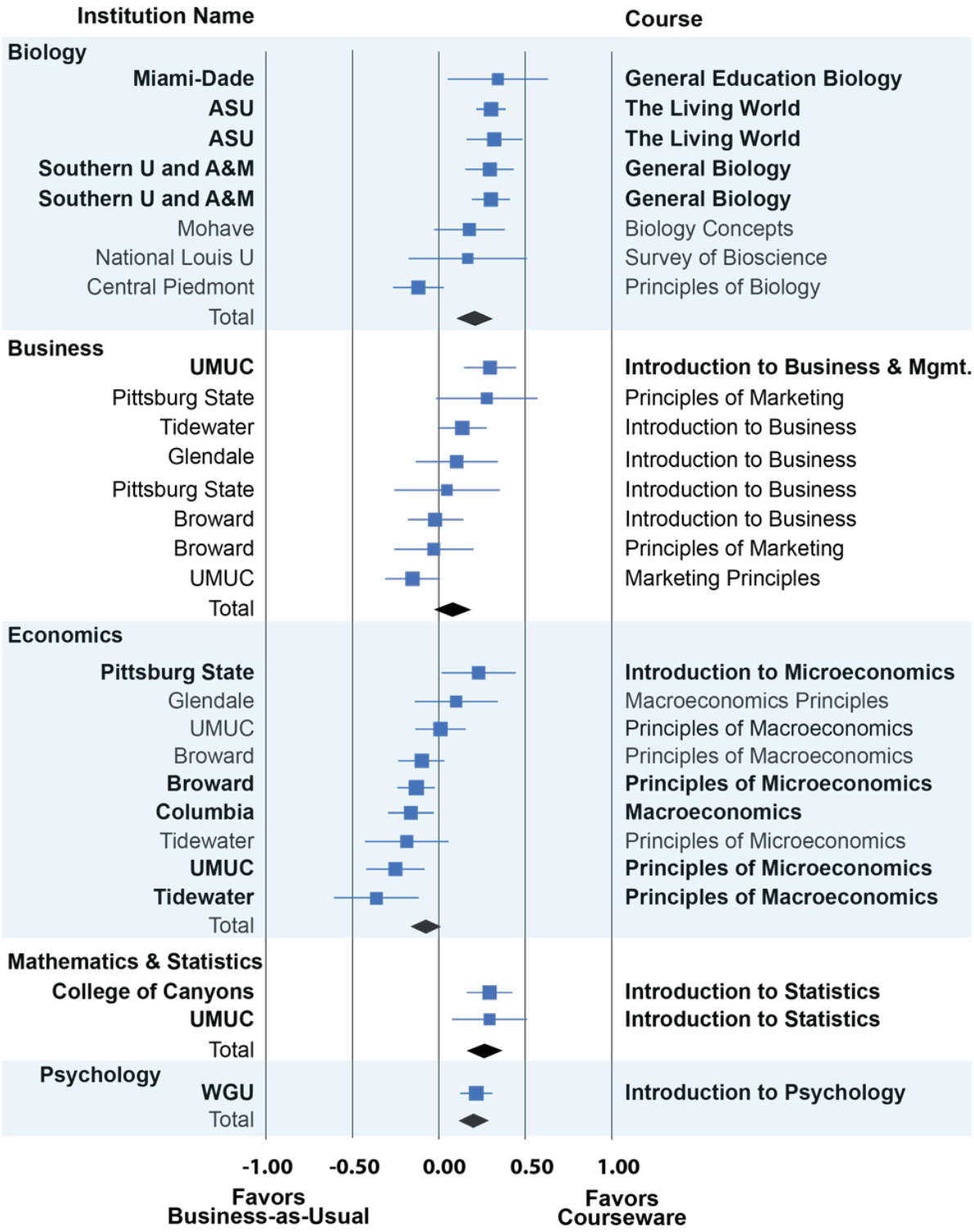
The courseware impact estimate varied also by course student:teacher ratio. **Implementations where the instructors taught groups larger than 50 students appeared to have more positive outcomes than studies where the class sections were smaller.** Figure 6 illustrates the relationship between student:teacher ratio and courseware impact. It may be that courseware is particularly useful in cases where instructors are dealing with more students than they can attend to individually. If one assumes that these larger courses were lecture-dominated in the past, the move to blended learning incorporating adaptive courseware would likely increase the amount of active learning, which is known to improve learning outcomes.

Figure 5. Impact Study Effect Estimates by Modality Contrast



Boldface indicates that the impact estimate is statistically significant (i.e., we can be confident that the difference in average grades for students in courseware and business-as-usual course sections did not occur by chance). In courseware implementations that are not in boldface, we cannot rule out the possibility that the observed difference in courseware and business-as-usual section average grades was attributable to chance.

Figure 6. Impact Study Effect Estimates by Class Size



Boldface indicatesthat the impact estimate is statistically significant (i.e., we can be confident that the difference in average grades for students in courseware and business-as-usual course sections did not occur by chance). In courseware implementations that are not in boldface, we cannot rule out the possibility that the observed difference in courseware and business-as-usual section average grades was attributable to chance.

One of the things we noticed in examining instructor survey responses is that instructors who volunteered to use the courseware had more positive perceptions of it. It seemed reasonable to conjecture that courseware implementations by volunteer instructors might be better and hence lead to stronger student outcomes than those by instructors who were required to use the courseware. When the impact estimates were analyzed by instructor volunteer status, however, we found that although impact estimates tended to be more positive in cases where courseware-using instructors had volunteered to use the product than when they had been required to use it, the difference did not attain statistical significance.

Other instructor features examined in the meta-analysis included whether or not the course version using the courseware was taught by a tenured or tenure-track faculty member as opposed to an instructor or adjunct and whether or not the person teaching it was teaching full time versus part time. Courseware impact estimates did not vary significantly between faculty and other kinds of instructors. There was a difference, however, based on whether instructors using the courseware were teaching full time. **Courseware impacts were smaller in studies where most of the instructors using the courseware were employed part time.** One might expect this condition to be more common in two-year colleges than in four-year colleges, but that was not the case (only 2 of the 8 studies involving mostly part-time instructors were conducted in two-year colleges). But instructor employment status did vary with the modality of instruction. In three-quarters of the studies where instructors using the courseware were all or mostly part-time employees, an online course using the courseware was being compared to an online course without the NGCC product.

We also looked at whether the instructors implementing the NGCC courseware were using it for the first time as part of the implementation study. This was the case for all the instructors in four impact studies and the majority of instructors in another two. All of the instructors in 15 of the studies had implemented the courseware previously, but this did not result in any discernible advantages in terms of their students' learning outcomes.

The value of these moderator variable analyses is limited to the extent that multiple conditions co-occur in many of the implementation studies. For example, as noted above, most of the studies where courseware instructors were teaching part time were also cases of contrasting two versions of online teaching. Under these circumstances, we must be cautious about interpreting patterns in the data shown in Figures 3-6.

Conditions Associated with Stronger NGCC Courseware Impacts

- Course taught in 4-year college
- Subject is Science, Math/Statistics or Psychology
- Instruction with courseware compared to instruction occurring primarily face-to-face
- Class sections of more than 50 students
- Courseware instructor is teaching full time.

What implementation practices are associated with better courseware outcomes?

In addition to looking at the conditions under which courseware was being used, as summarized above, we also examined a number of support practices for courseware implementation. The practices we examined included receipt of training on how to use the courseware, receipt of training on how to integrate the courseware with instruction, number of hours of training, vendor support, campus leader support, support from colleagues, and campus IT support. Surprisingly, none of these training and support variables was a significant moderator of courseware effectiveness. Failure to find any practices that moderated courseware 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.

To provide a larger set of studies for exploring practices as moderators of courseware effects, we combined data from the 28 NGCC impact studies with data from the 12 earlier adaptive courseware implementations examined by Yarnall, Means, and Wetzell (2016). A meta-analysis of the resulting 40 adaptive courseware implementation studies This larger meta-analysis also uncovered a number of practices associated with more positive impacts for adaptive courseware implementations:[20]

- Instructors volunteering to implement the courseware
- Training for instructors on how to integrate the courseware with one's intended pedagogy[21]
- Campus leader support
- Colleague or peer support
- Prior experience teaching with the adaptive courseware

20 Findings reported earlier for more positive impacts in four-year colleges, in science and psychology courses, and when shifting from face-to-face to blended learning held also for this larger study sample.

21 Impacts did not vary depending on whether or not instructors had received training on how to use the product per se.

Practices Associated with More Positive Courseware Impacts

- Working with instructors who volunteer to try out the courseware
- Providing training for instructors on how to integrate the courseware into their practice
- Demonstrations of support for courseware use on the part of campus leaders
- Peer support from colleagues implementing the same courseware

Are these impact findings related to the strength of the study design?

It is not unusual to find stronger impacts for an educational intervention in those studies with a weaker research design. For the NGCC evaluation we coded each impact study in terms of a number of characteristics related to the strength of the study--namely, sample size, whether the comparison group was taking the course at the same time as the treatment group, and whether or not the same instructors taught both courseware and comparison course sections. We did not code the studies for the rigor of their research design per se because all of the impact studies were either quasi-experimental or observational in nature. None of them used a true experimental design (with students and instructors randomly assigned to condition), leaving open the possibility that observed differences were a function of differences between instructors and students in the two courseware conditions rather than the contribution of the courseware itself. Our analytic model controlled for student characteristics likely to be related to course outcomes (as discussed above), but we could not control for instructor differences.

Among the three study variables we tested as possible moderators of courseware impact (sample size, condition timing, and instructor overlap), only the last of these made a significant difference. **Impact studies in which there was no overlap between instructors in the NGCC courseware and comparison course sections tended to find more positive effects.** This finding raises the possibility that where courseware and non-courseware sections differed significantly, the instructors rather than the use of the courseware product might have been responsible. It also underscores the value of assigning instructors to courseware treatment conditions so that courseware impacts can be disentangled from instructor effects when rigorous testing of courseware impacts is needed.

Subgroup Analyses

Because the foundation's strategic goal for postsecondary education focuses on low-income and under-represented minority students, we performed separate analyses of courseware impacts for these two student subgroups. (African American and Latino students were combined to obtain greater statistical power.) Some earlier research suggests that low-income and under-represented minority students perform more poorly in online and blended learning courses than in conventional face-to-face courses (Figlio, Rush, & Yin, 2013; Jaggers, 2011), which would lead to the expectation that these subgroups would do better in the BAU condition than in the NGCC courseware condition of impact studies.

However, these studies involved earlier generations of online learning resources without the interactive and adaptive elements of NGCC courseware.

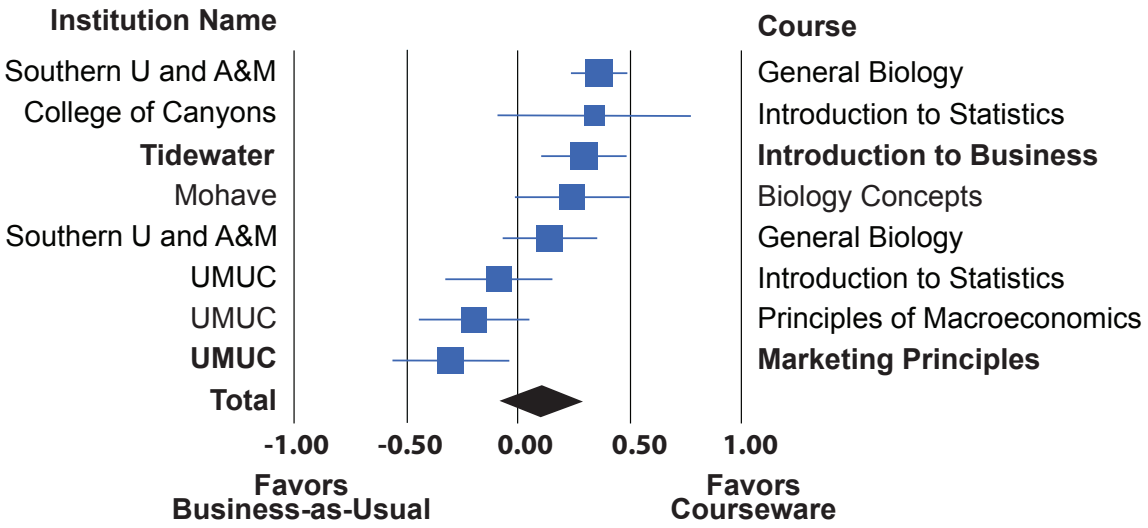
For these student subgroup impact analyses, we applied the same screens for minimum sample size and baseline equivalence (for student characteristics other than the one defining the subgroup) as we did for the analyses described above for the total student sample. For low-income students, seven of the datasets met the sample size and baseline equivalency criteria; ten of the under-represented student datasets met these criteria.

Figure 7 shows the courseware effect estimates for low-income students, and Figure 8 shows estimates for under-represented minority students.

Although the average effect size for low-income students' grades (+0.10) did not attain statistical significance, it is on a par with the effect size for students overall (+.09) and it is clear that the use of courseware does not generally put low-income students at a disadvantage. There was only one case among the seven studies in this meta-analysis in which low-income students earned better grades in the BAU version of the course. In two cases, low-income students earned significantly better grades in the NGCC version of the course, and in four cases there was no significant effect of course version on low-income students' grades.

The results for under-represented minority students (African American or Latino) provide further indication that courseware use does not have inverse impacts for the students who are the focus of the foundation's postsecondary strategy. **The average courseware impact on under-represented students' grades was an improvement of +0.16 standard deviation units, which was statistically significant.** In the ten individual studies of course outcomes for under-represented minority students, five found significantly better outcomes in the courseware condition than in BAU. There was only a single courseware implementation where minority students fared worse in the courseware condition than with business

Figure 7. NGCC Courseware Impacts for Low-Income Students

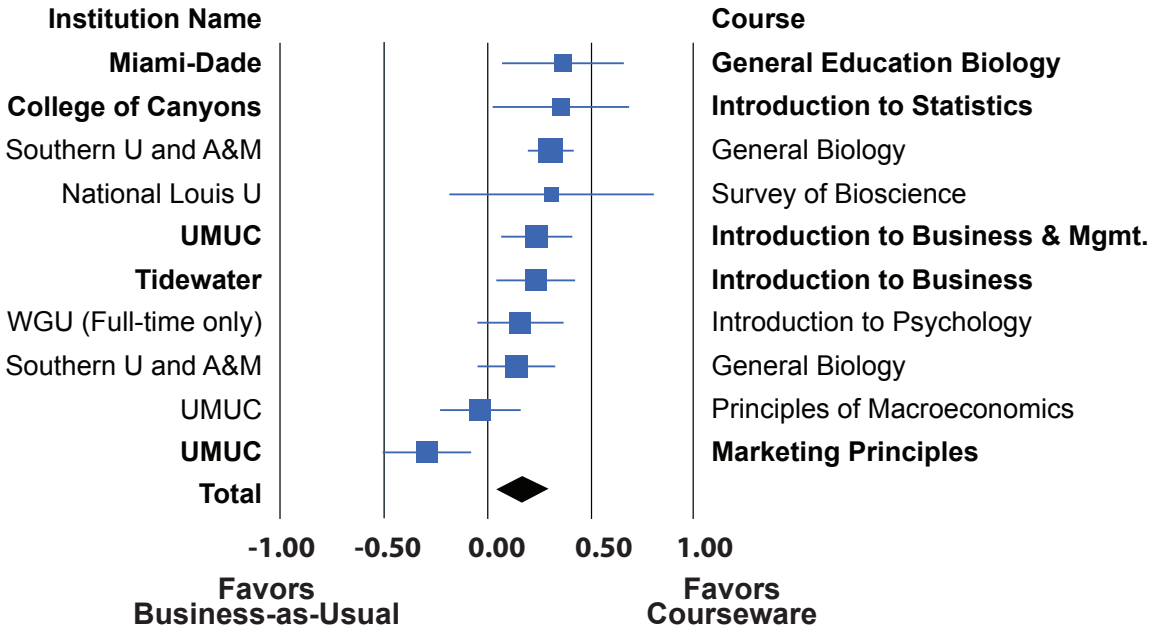


Boldface indicates that the impact estimate is statistically significant (i.e., we can be confident that the difference in average grades for students in courseware and business-as-usual course sections did not occur by chance). In courseware implementations that are not in boldface, we cannot rule out the possibility that the observed difference in courseware and business-as-usual section average grades was attributable to chance.

as usual (the same implementation for which low-income students did worse with the courseware). In four datasets student outcomes were equivalent in the two versions of the course.

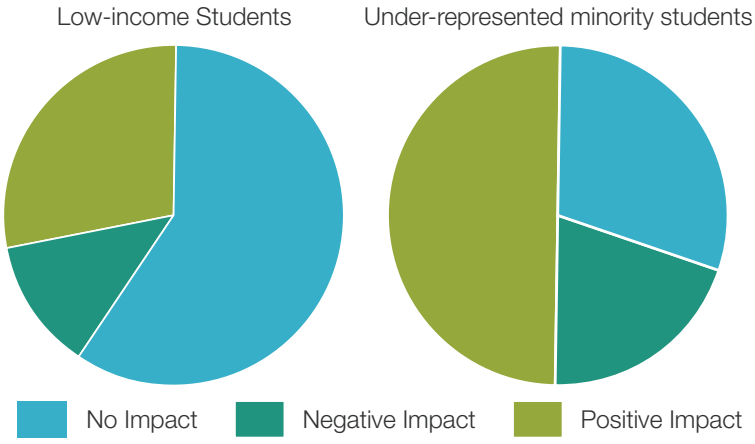
The number of impact studies for which we could do these subgroup analyses was rather small, but these results are encouraging. Figure 9 summarizes the impact findings for low-income and under-represented minority students.

Figure 8. NGCC Courseware Impacts for Under-represented Minority Students



Boldface indicates that the impact estimate is statistically significant (i.e., we can be confident that the difference in average grades for students in courseware and business-as-usual course sections did not occur by chance). In courseware implementations that are not in boldface, we cannot rule out the possibility that the observed difference in courseware and business-as-usual section average grades was attributable to chance.

Figure 9. NGCC Impacts on Grades for Low-Income and Under-represented Minority Students



Instructor Perceptions of NGCC Courseware

Courseware impacts are not the only factor influencing market reactions to these educational resources, of course. Ease of use, availability of implementation supports, and perceived value are additional considerations. To capture these dimensions, SRI administered an online survey to all instructors who used an NGCC courseware product with one or more of their classes in fall 2016. To identify the survey sample, SRI asked the grantees to provide a list of names and email addresses for all instructors using their courseware that term.

The online NGCC Instructor Survey addressed topics concerning courseware use at the classroom level, such as how the courseware was implemented, supports sought and received for courseware implementation, perceptions of the courseware, and future plans for using the courseware or recommending it to others. To support analyses of the courseware's cost effectiveness, additional survey items asked about the amount of time the instructor spent on various functions related to preparing for and implementing instruction with the courseware and for comparisons of these time estimates to those for the same functions without using adaptive courseware.

After fall 2016, SRI surveyed instructors using NGCC products in subsequent terms (spring or fall 2017) if data from that term was to be used in a study of the product's impact on student learning. In all, 550 instructors out of the 658 from whom SRI requested surveys, submitted responses, for a response rate of 78%. Survey responses for each grantee's instructors using products in fall 2016 or in 2017 are shown in Appendix B. Below we highlight selected instructor survey responses aggregated across all grantees.

A majority of surveyed NGCC instructors (70%) had a choice in whether or not to use the courseware in their classes. The overwhelming majority of instructors reported that their motivations for trying out the courseware included the expectation that it would enhance student engagement (87%), their desire to increase the amount of individualized instruction in their course (84%), and their interest in exploring online teaching and learning (72%).

A majority of instructors felt adequately or well prepared to use their NGCC courseware (69%). Most instructors had participated in some form of formal training for using the courseware (78%), and a majority also received some kind of support other than formal training (56%). Of the 56%, nearly all received support from courseware technical and support staff (85%), and slightly over half (51%) received support from colleagues who were also using the courseware. Both formal training and additional support were on average perceived as being helpful and satisfying.

Most instructors who used NGCC courseware had experience with online or blended learning prior to using the NGCC product (67%). **Instructors reported spending an average of approximately 8.37 hours learning to use the courseware and 16.24 hours integrating the courseware into**

their courses, though the range of reported hours was very wide, with some instructors reporting spending zero hours while others reported spending 40 or more hours.

Roughly a third (32%) of instructors described the NGCC courseware as a core component of their course that substituted for a printed text. This practice has potential to reduce the course costs incurred by students. One out of seven NGCC instructors (14%) said they used the courseware in a fully online course. Just 9% of instructors reported that they used the courseware in a "flipped" classroom format. The most frequently used instructor-facing courseware features were: the online gradebook, dashboards of class-level and student-level progress, and making class materials available to students.

After implementing the courseware, **a majority of instructors felt the NGCC courseware had improved teaching and learning in their course.** In terms of how courseware brought about improvements, over half of instructors agreed that the courseware provided the following benefits for their instructional practice:

- supporting students in deeper learning (63%),
- increasing student engagement with course content (63%),
- better monitoring of individual student progress (57%),
- improved tracking of whole-class progress (53%), and
- presenting content more effectively (52%).

Most instructors agreed that using the courseware provided the following benefits for their students' learning:

- better understanding and remembering of course content (66%),
- staying more engaged with the course overall (64%), and
- better analysis and application of course content (62%).

Overall, **the great majority of NGCC instructors reported being moderately or highly satisfied with the courseware** (88%). Eighty percent said they planned to use the NGCC product in their course in the future. Instructors said they were somewhat likely to recommend the courseware they used to a friend or colleague teaching the same course (average response 6.52 on a scale from 0 = Extremely Unlikely to 10 = Extremely Likely with 5= Neither Likely nor Unlikely).

SRI researchers' visits to pilot implementation sites where they could observe courseware in use and interview teachers and students revealed aspects of the NGCC courseware that were viewed positively:

Both instructors and students **liked the interactive elements of the courseware;** they found them engaging and believed that they were conducive to deeper learning.

Students also liked **having formative assessments to check their understanding,** provided that the assessments were perceived as relevant to preparing them for course tests and grades.

Instructors liked the use of adaptive formative assessment activities and hints. Students liked them without necessarily being aware they were adaptive.

At several sites, instructors said they thought the **courseware was increasing the time they could spend interacting with students.** Some described flipping the classroom, and others said it reduced the time they had to spend grading and justifying their grades to disgruntled students.

Courseware Cost Study and Cost Effectiveness

To make good decisions about implementing particular instructional interventions, educators need to understand the likely costs as well as the likely benefits. Cost is a practical consideration that can dramatically shape how knowledge about effective practices is translated into action in districts. Reliance on effectiveness alone may encourage adoption of interventions that are too expensive to sustain with fidelity (Bakia, Caspary, Wang, Dieterle, & Lee, 2011; Harris, 2009; Hollands et al., 2014). Analytic approaches that examine costs are relevant in the context of rising prices in education and decreasing educational budgets (Bowen, 2013; Hollands et al., 2014). In addition to questions of impact and efficiency, policy-makers and administrators require information related to affordability to address basic questions such as: Will a new program or approach increase costs, and if so, by how much? While cost-analyses of educational interventions are not yet common, studies of cost and cost-effectiveness are readily available in the health and human services sector.

The set of NGCC implementations for which we are conducting cost and cost effectiveness analyses is limited to those combinations of grantee products, sites, and courses for which we have usable impact study data. A cost model was developed for nine fall 2016 impact datasets involving products from four grantees (CogBooks, Lumen, OLI, and Smart Sparrow).

Data for the cost analyses were collected primarily from:

- NGCC instructor surveys
- administrative and publicly available data regarding salaries and material costs
- interviews with instructors and administrators at selected sites
- implementation information gathered from grantees by their SRI liaisons

For each cost analysis all relevant data were entered into a template that captured possible cost impacts for setting up and delivering courses with and without the courseware, both in the initial year and on an ongoing basis. Following Levin et al. (2017), we took an “ingredients” approach, identifying all inputs regardless of whether administrators, faculty members, or students bore the costs. These categories included the costs of providing instruction (facilities and technology, staff professional development, administrative and technical support, course restructuring and system setup, differences in staff teaching time), and differences in access costs for students (subscription fees, textbook costs). Staff labor estimates took into account the staff role and salary levels (e.g., faculty members versus teaching

assistants). Cost estimates were calculated for the academic term for which course impact data were collected, as well as any expenses related to initial product set up and integration.

The results of cost effectiveness analyses are often depicted in what is called a cost effectiveness plane, such as that shown in Figure 10. Each quadrant in the plane represents one of the four possible combinations of relative cost and relative effectiveness. Specifically, an intervention could be (1) less expensive but also less effective than the alternative, (2) less expensive and more effective, (3) more expensive and more effective, or (4) more expensive and less effective relative to the alternative. Clearly, an intervention falling in quadrant 2 (more effective and less costly) would be the ideal case, and one falling into quadrant 3 (more expensive and less effective) is least desirable. Often, however, the intervention being evaluated is not better on both the cost and the effectiveness dimensions, making it more difficult to decide what to do on the basis of cost effectiveness analyses. It is common for an intervention to fall into quadrant 3 (more effective and more costly than the usual approach), and there are also interventions that are less effective but less costly (quadrant 1). Whether or not decisionmakers want to pursue interventions falling into either of these two quadrants depends on the relative value they place on cost savings versus effectiveness (Levin et al., 2017).

Figure 10. The Cost Effectiveness Plane

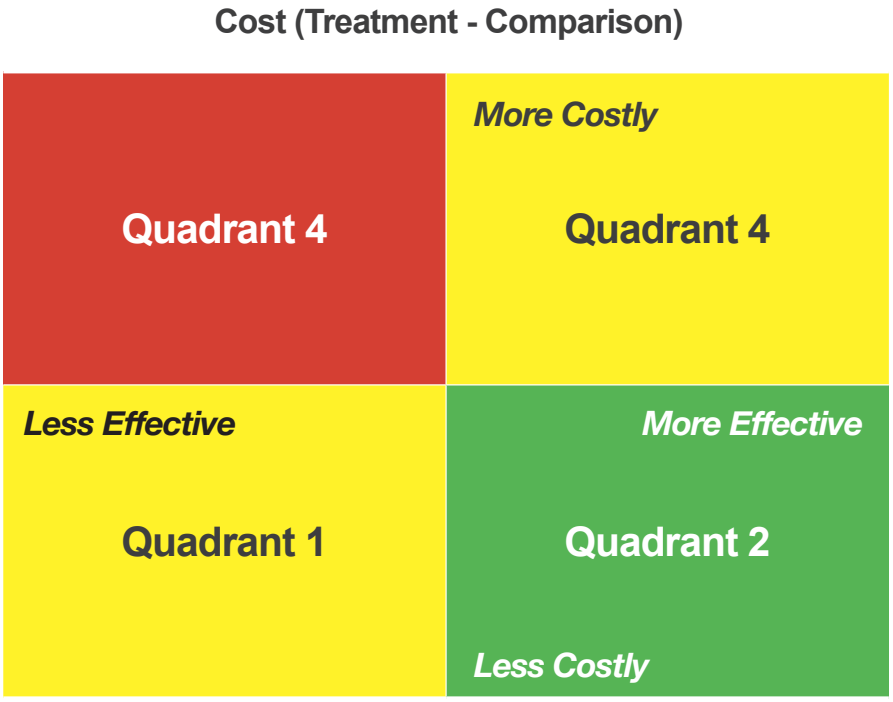


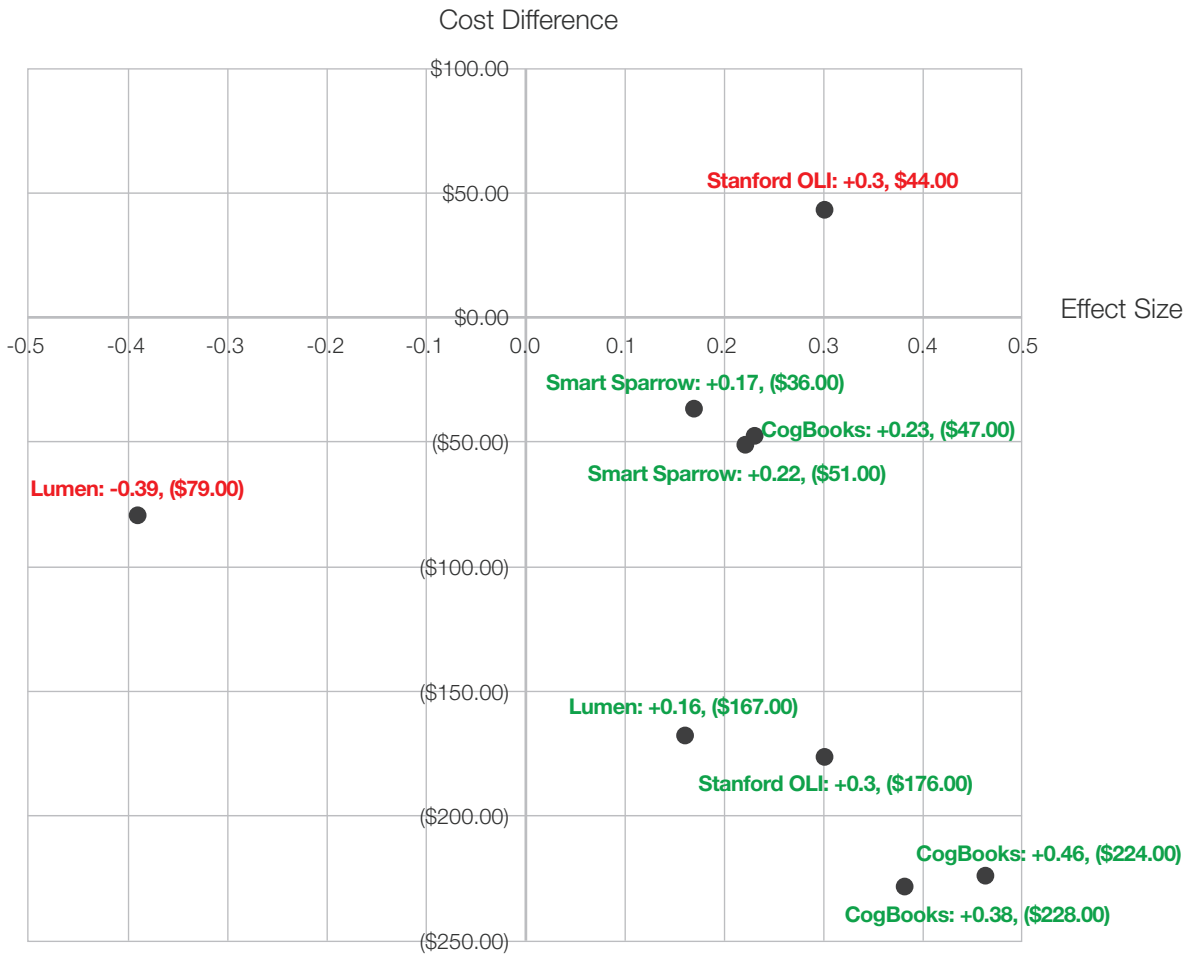
Table 10 shows the incremental costs/savings associated with using courseware in the nine NGCC cost effectiveness analyses alongside the corresponding impact on course grades (from Table 8).

Table 10. Cost Effectiveness Analyses: Effect Size and Cost Difference

Courseware	Institution and Course	Effect size (g)	Cost
CogBooks	Arizona State University, Biology 100	+0.23	**$47**
CogBooks	Southern University and A&M College, General Biology 104	+0.38	**$228**
CogBooks	Southern University and A&M, General Biology 105	+0.46	**$224**
Lumen	Tidewater Community College, Business 100	+0.16	**$167**
Lumen	Tidewater Community College, Economics 201	-0.39	**$79**
Stanford OLI	University of Maryland-University, Statistics 200	+0.30	**($44)**
Stanford OLI	College of the Canyons, Math 140	+0.30	**$176**
Smart Sparrow	Mohave Community College, BIO 100	+0.22	**$51**
Smart Sparrow	National University Biology 100	+0.17	**$36**
Average		**+0.20**	**$107.11**

Figure 11 shows the nine NGCC cost effectiveness analysis results arrayed on the cost effectiveness plane.[22] As the figure shows, 7 of the 9 analyses fell into quadrant 2—courseware was more effective and less costly than business as usual. One result fell into quadrant 3 (more effective and more costly) and one into quadrant 4 (less effective and less costly). Thus, in 8 out of 9 cases, courseware use led to cost savings. These savings stemmed primarily from avoidance of textbook costs for students. Importantly, these cost savings were not achieved by compromising student learning. As already noted, students in the courseware condition earned higher course grades than those in the business-as-usual version of the course in 8 of these 9 cost effectiveness studies.

Figure 11. NGCC Studies on the Cost Effectiveness Plane



22 The student sample sizes and semesters of data used for the cost analysis are, in some cases, different than those reported in the overall effect size and other analyses reported in the previous sections of this report.

We cannot make strong claims about the generalizability of these nine cases. We had adequate data for estimating costs for only 9 out of the 28 NGCC courseware implementations with efficacy estimates, and this sample is not necessarily representative of all NGCC courseware implementations yet alone of courseware use in general. Moreover, cost estimates are very sensitive to the amount of time the instructor spends preparing for and delivering the course in both treatment and comparison conditions, and instructor practices vary markedly. But we can say that the preliminary evidence available to us suggests that high-quality courseware can be cost effective. Our analyses show that if the initial startup costs of implementing courseware are amortized over the number of terms for which the institution expects to use the courseware and costs to students are factored in, courseware can contribute to increased efficiency in higher education. For the nine NGCC cases for which we had adequate data for a cost-effectiveness analysis, use of NGCC courseware moved the average student's performance from the 50th to the 58th percentile while saving approximately $107 per student. Cost details for the nine individual cost analyses appear on the pages that follow.

Courseware Cost Case Studies

CogBooks in Arizona State University Biology 100

- Term: Fall 2016
- Course: BIO 100
- Number of students considered in the cost effectiveness analysis: 437
- Business as Usual (BAU) Comparison: Lecture course with textbook in fall 2014
- Impact estimate for effect on course grade: 0.23
- Average section sizes: 66 treatment, 201 BAU

Cost Components

Analysis Level	Cost Element	Cost Difference/ Institution	Cost Difference/ Student
Student-level	Material (software vs. textbook)		-$70
Instructor-level	Equipment (e.g. classroom renovation, computers)	$0	$0
	Instructional design (e.g. instructor labor, instructional design staff)	$8,400	$19
	Instructor professional development and training (including TAs)	$1,260	$3
	Teaching time difference (e.g. preparation, instructional time, grading)	$0	$0
	Other campus staff (e.g. technical/administrative support)	$500	$1
	Communication (e.g. within campus, with vendors)	$0	$0
Overall			**-$47**

Material (software vs. textbook):

- The largest cost difference between the courseware and BAU version of the course was the student subscription fee associated with CogBooks in relation to the BAU textbook. This provided a savings of $70 per student.

Equipment (e.g. classroom renovation, computers):

- No facilities costs were incurred specifically for use of CogBooks at ASU. ASU taught the CogBooks BIO 100 course in a room built for active learning, which included a flat floor (vs. tiered seating), round tables for 6, seating for 75 people, white boards for each table, high volume Wi-Fi, and an audiovisual system with projector and microphones. ASU would have built this room regardless of its use of CogBooks, so this room was not considered a CogBooks-related expense for the courseware implementation.
- Students were required to bring their own laptops so there were no associated computer costs.

CogBooks in Arizona State University Biology 100 *(cont'd.)*

Instructional design (e.g. instructor labor, instructional design staff):

- Administrator time and Instructional designer supporting the integration were provided in the preparation phase for CogBooks usage in the biology course. After initial implementation, ASU incurred no further ongoing costs for administrator or instructional designer support.
- Administrator spent time supporting the integration and use of CogBooks in the preparation phase. ASU incurred no ongoing costs for administrative support after the initial implementation.
- Two faculty members were given release time by their department to work on integrating the BIO 100 course materials into CogBooks. This included reviewing and editing the open-source textbook, rewriting exams, and designing active learning lessons. Three other faculty members provided validation work of the CogBooks BIO 100 course, reviewing content, correcting errors, and revising materials.

Instructor professional development and training (including TAs):

- Initial professional development was provided for 4 faculty members for the fall 2016 semester.
- On a yearly basis, Teaching Assistants (TAs) participate in a training workshop.

Teaching time difference (e.g. preparation, instructional time, grading):

- For faculty members, CogBooks did not save or cost additional instructional time overall.

Other campus staff (e.g. technical/administrative support):

- On-campus technology support was provided in the preparation phase and the first semester of CogBooks use. ASU incurred no ongoing costs for on-campus technology support after initial implementation.

Cost Effectiveness

Implementation of CogBooks at ASU in fall 2016 lowered costs and provided better academic results compared to business as usual in a prior term.

CogBooks in Southern University and A&M College General Biology 104

- Term: Fall 2016
- Course: BIO 104
- Number of students considered in the cost effectiveness analysis: 283
- Business as Usual (BAU) Comparison: Lecture course with textbook in spring 2017
- Impact estimate for effect on course grade: 0.38
- Average section sizes: 56 treatment, 62 BAU

Cost Components

Analysis Level	Cost Element	Cost Difference/ Institution	Cost Difference/ Student
Student-level	Material (software vs. textbook)		-$236
	Equipment (e.g. classroom renovation, computers)	$0	$0
	Instructional design (e.g. instructor labor, instructional design staff)	$1,365	$5
Instructor-level	Instructor professional development and training (including TAs)	$0	$0
	Teaching time difference (e.g. preparation, instructional time, grading)	$478	$2
	Other campus staff (e.g. technical/administrative support)	$0	$0
	Communication (e.g. within campus, with vendors)	$328	$1
Overall			**-$228**

Material (software vs. textbook):

- The largest cost difference between the courseware and BAU version of the course was the student subscription fee associated with CogBooks in relation to the BAU textbook. This provided a savings of $236 per student.

Equipment (e.g. classroom renovation, computers):

- Students were required to bring their own laptops so there were no associated computer costs. No facilities costs were incurred specifically for use of CogBooks at Southern University and A&M College since computer labs and other online learning resources were already available.

CogBooks in Southern University and A&M College General Biology 104 *(cont'd.)*

Instructional design (e.g. instructor labor, instructional design staff):

- The BIO 104 course coordinator and 2 other lead instructors initially spent time integrating the course content into CogBooks. This included reorganizing the course content and rewriting the course PowerPoint slides.

Instructor professional development and training (including TAs):

- Not affecting the cost of the treatment condition, were professional development supports for faculty, since these were similar across the CogBooks and BAU conditions.

Teaching time difference (e.g. preparation, instructional time, grading):

- Increased time instructors spent in course preparation and working with students.

Communication (e.g. within campus, with vendors):

- Communication and problem solving between course faculty and the product developer, for example over issues sending email to their students was reported in the first semester of product use.

Cost Effectiveness

Implementation of CogBooks at Southern University and A&M College in spring 2017 lowered costs and provided better academic results compared to business as usual in the same term.

CogBooks in Southern University and A&M College General Biology 105

- Term: Fall 2016
- Course: BIO 105
- Number of students considered in the cost effectiveness analysis: 224
- Business as Usual (BAU) Comparison: Lecture course with textbook in fall 2016
- Impact estimate for effect on course grade: 0.46
- Average section sizes: 66 treatment, 73 BAU

Cost Components

Analysis Level	Cost Element	Cost Difference/ Institution	Cost Difference/ Student
Student-level	Material (software vs. textbook)		-$236
Instructor-level	Equipment (e.g. classroom renovation, computers)	$0	$0
	Instructional design (e.g. instructor labor, instructional design staff)	$1,743	$8
	Instructor professional development and training (including TAs)	$0	$0
	Teaching time difference (e.g. preparation, instructional time, grading)	$637	$3
	Other campus staff (e.g. technical/administrative support)	$0	$0
	Communication (e.g. within campus, with vendors)	$418	$2
Overall			**-$224**

Material (software vs. textbook):

- The largest cost difference between the courseware and BAU version of the course was the student subscription fee associated with CogBooks in relation to the BAU textbook). This provided a savings of $236 per student.

Equipment (e.g. classroom renovation, computers):

- Students were required to bring their own laptops so there were no associated computer costs. No facilities costs were incurred specifically for use of CogBooks at Southern University and A&M College since computer labs and other online learning resources were already available.

CogBooks in Southern University and A&M College General Biology 105 *(cont'd.)*

Instructional design (e.g. instructor labor, instructional design staff):

- The BIO 105 course coordinator and 2 other lead instructors initially spent time integrating the course content into CogBooks. This included reorganizing the course content and rewriting the course PowerPoint slides.

Instructor professional development and training (including TAs):

- Not effecting the cost of the treatment condition were professional development supports for faculty, since these were similar across the CogBooks and BAU conditions.

Teaching time difference (e.g. preparation, instructional time, grading):

- Increased time instructors spent in course preparation and working with students.
- Communication (e.g. within campus, with vendors):
- Communication and problem solving between course faculty and the product developer, for example over issues sending email to their students was reported in the first semester of product use.

Cost Effectiveness

Implementation of CogBooks at Southern University and A&M College in spring 2017 lowered costs and provided better academic results compared to business as usual in the same term.

Lumen Learning in Tidewater Community College Business 100

- Term: Fall 2016
- Course: BUS 100
- Number of students considered in the cost effectiveness analysis: 349
- Business as Usual (BAU) Comparison: Regular online course without Lumen software in fall 2016
- Impact analysis effect size: 0.16
- Average section sizes: 24 treatment, 21 BAU

Cost Components

Analysis Level	Cost Element	Cost Difference/ Institution	Cost Difference/ Student
Student-level	Material (software vs. textbook)		-$160
	Equipment (e.g. classroom renovation, computers)	$0	$0
	Instructional design (e.g. instructor labor, instructional design staff)	$1,905	$5.46
Instructor-level	Instructor professional development and training (including TAs)	$520	$1.49
	Teaching time difference (e.g. preparation, instructional time, grading)	-$5,611	-$16
	Other campus staff (e.g. technical/administrative support)	$21	$0.06
	Communication (e.g. within campus, with vendors)	$395	$1.13
Overall			**-$167**

Material (software vs. textbook):

- The largest cost difference was the student subscription fee associated with Lumen Waymaker in relation to the BAU textbook for one semester. This provided a savings of $160 per student.

Equipment (e.g. classroom renovation, computers):

- No equipment or facilities costs were incurred specifically for use of Lumen Waymaker at TCC. There were no differential costs with respect to equipment and facilities; sections that used Lumen Waymaker did not require any additional facilities or equipment beyond that which BAU sections used.

Lumen Learning in Tidewater Community College Business 100 *(cont'd.)*

Instructional design (e.g. instructor labor, instructional design staff):

- Within the Business department, an administrator and several faculty members consulted on the course redesign, making it possible to use Lumen Waymaker in all sections of the course. In addition, the administrator and several faculty members spent time supporting the ongoing integration and use of Lumen Waymaker in fall 2016. After initial implementation, TCC incurred no ongoing costs for administrator or faculty support of course redesign and integration of Lumen Waymaker.
- Faculty were offered stipends to pilot the use of Lumen Waymaker in BUS 100 for the fall 2015 semester.

Instructor professional development and training (including TAs):

- Initial professional development was provided for one administrator and faculty. After initial implementation, TCC incurred no ongoing costs for professional development for either the administrator or faculty.

Teaching time difference (e.g. preparation, instructional time, grading):

- For faculty members, Lumen Waymaker saved instructional time overall for all instructors. The primary driver for time saving was that instructors were provided with a "master course" shell that reduced pre-course preparation time.

Other campus staff (e.g. technical/administrative support):

- Minimal technology support was provided in the preparation phase, from both the Virginia Community College System level and TCC Campus IT. TCC incurred no ongoing technology support costs after initial implementation.

Communication (e.g. within campus, with vendors):

- Administrators and senior leadership spent time in communication with the vendor during the initial fall 2016 semester. TCC incurred minimal ongoing costs associated with communication with the vendor after the initial implementation.

Cost Effectiveness

Using Lumen Waymaker at TCC in fall 2016 lowered costs relative to BAU while providing better academic results.

Lumen Learning in Tidewater Community College Economics 201

- Term: Fall 2016
- Number of students considered in the cost effectiveness analysis: 46
- Business as Usual (BAU) Comparison: Regular online course without Lumen software in fall 2016
- Impact analysis effect size: -0.39
- Average section sizes: 21 treatment, 29 BAU

Cost Components

Analysis Level	Cost Element	Cost Difference/ Institution	Cost Difference/ Student
Student-level	Material (software vs. textbook)		-$190
Instructor-level	Equipment (e.g. classroom renovation, computers)	$0	$0
	Instructional design (e.g. instructor labor, instructional design staff)	$4,036	$67
	Instructor professional development and training (including TAs)	$1,788	$30
	Teaching time difference (e.g. preparation, instructional time, grading)	$250	$4
	Other campus staff (e.g. technical/administrative support)	$84	$1
	Communication (e.g. within campus, with vendors)	$455	$8
Overall			**-$79**

Material (software vs. textbook):

- The largest cost difference was the student subscription fee associated with Lumen Waymaker relative to the cost of the BAU textbook for one semester. This provided a savings of $189.50 per student.

Equipment (e.g. classroom renovation, computers):

- No equipment or facilities costs were incurred specifically for use of Lumen Waymaker at TCC. There were no differential costs with respect to equipment and facilities. Sections that used Lumen Waymaker did not require any additional facilities or equipment beyond that which BAU sections used.

Lumen Learning in Tidewater Community College Economics 201 *(cont'd.)*

Instructional design (e.g. instructor labor, instructional design staff):

- Faculty spent time in course redesign and the integration of Lumen Waymaker into the economics course, as well as supporting ongoing integration and use of Lumen Waymaker in the initial semester of Fall 2016.
- Lumen Waymaker staff spent time modifying instructional materials and assessments in response to faculty feedback during the fall 2016 semester.

Instructor professional development and training (including TAs):

- Initial professional development was provided for one administrator and the participating faculty member. After initial implementation, TCC incurred no ongoing costs for professional development for either the administrator or faculty.

Teaching time difference (e.g. preparation, instructional time, grading):

- One faculty member was provided a stipend to pilot the use of Lumen Waymaker in ECO 201 for the fall 2016 semester only.

Other campus staff (e.g. technical/administrative support):

- Minimal technology support was provided in the preparation phase, either by the Virginia Community College System or by TCC Campus IT. TCC incurred no ongoing technology costs after initial implementation.

Communication (e.g. within campus, with vendors):

- Administrators and senior leadership spent time in communication with the vendor during the initial fall 2016 semester. TCC incurred minimal ongoing costs associated with communication with the vendor after the initial implementation.

Cost Effectiveness

Implementing Lumen Waymaker in the TCC economics course in fall 2016 lowered costs but resulted in lower course grades compared to BAU.

Stanford OLI in University of Maryland-University College Statistics 200

- Term: Fall 2016
- Course: STAT 200
- Number of students considered in the cost effectiveness analysis: 60
- Business as Usual (BAU) Comparison: Regular UMUC online course without Stanford/OLI software*
- Impact estimate for effect on course grade: 0.30
- Average section sizes: 30 treatment, 30 BAU

* An academic term at UMUC is 8 weeks long, rather than the typical 16 weeks at conventional colleges. During fall 2016 each STAT 200 instructor taught two 8-week terms. We selected an 8-week term as our length of intervention, and used the number of students that would enroll in one academic term.

Cost Components

Analysis Level	Cost Element	Cost Difference/ Institution	Cost Difference/ Student
Student-level	Material (software vs. textbook)		$15
	Equipment (e.g. classroom renovation, computers)	$0	$0
	Instructional design (e.g. instructor labor, instructional design staff)	$264	$4
Instructor-level	Instructor professional development and training (including TAs)	$73	$1
	Teaching time difference (e.g. preparation, instructional time, grading)	$981	$16
	Other campus staff (e.g. technical/administrative support)	$420	$7
	Communication (e.g. within campus, with vendors)	$0	$0
Overall			**$44**

Material (software vs. textbook):

- The largest cost difference was the institutional subscription fee associated with Stanford/OLI ($14,000 one-time fee). UMUC does not pass courseware fees along to students; there is no textbook/software fee for students in either condition.

Equipment (e.g. classroom renovation, computers):

- No equipment or facilities costs were incurred specifically for use of Stanford/OLI at UMUC. There were no differential costs with respect to equipment and facilities. Sections that used Stanford/OLI did not require any additional facilities or equipment beyond that which BAU sections used.

Stanford OLI in University of Maryland-University College Statistics 200 *(cont'd.)*

Instructional design (e.g. instructor labor, instructional design staff):

- A Learning Design & Solution team spent time preparing the course for the first implementation. UMUC's Content Operations also team spent time supporting the Stanford/OLI courses compared to BAU courses in the preparation phase.
- A department head and two faculty members were involved in course redesign and integrating Stanford/OLI into the statistics course. The department head's time supporting the initial integration and use of Stanford/OLI was the same amount of time that would be spent supporting BAU courses. After initial implementation, UMUC incurred no ongoing costs for department head or faculty support of course redesign and integration of Stanford/OLI.

Instructor professional development and training (including TAs):

- Initial professional development was provided for the department, for both tenured faculty and adjunct faculty.

Teaching time difference (e.g. preparation, instructional time, grading):

- For faculty members, Stanford/OLI implementation required additional instructional time each term. The primary driver for this time requirement was instructors' perception that the content was not at a level appropriate for their introductory statistics classes, and so spent approximately an hour per week explaining the more advanced problems with students.
- Faculty stipends were provided for faculty who participated in the pilot fall 2016 semester.

Communication (e.g. within campus, with vendors):

- The department head and UMUC senior leadership spent time time in communicating with the OLI vendor initially. After the initial implementation, UMUC did not experience significant ongoing costs associated with communication with the vendor.

Cost Effectiveness

Implementation of Stanford OLI in fall 2016 raised costs but provided better academic results compared to business as usual in a prior term.

Stanford OLI in College of the Canyons Mathematics 140

- Term: Fall 2016
- Course: MATH 140
- Number of students considered in the cost effectiveness analysis: 498
- Business as Usual (BAU) Comparison: Lecture course with textbook in spring 2017
- Impact estimate for effect on course grade: 0.30
- Average section sizes: 34 treatment, 32 BAU

Cost Components

Analysis Level	Cost Element	Cost Difference/ Institution	Cost Difference/ Student
Student-level	Material (software vs. textbook)		-$178
Instructor-level	Equipment (e.g. classroom renovation, computers)	$0	$0
	Instructional design (e.g. instructor labor, instructional design staff)	$0	$0
	Instructor professional development and training (including TAs)	$1,014	$2
	Teaching time difference (e.g. preparation, instructional time, grading)	$0	$0
	Other campus staff (e.g. technical/administrative support)	$0	$0
	Communication (e.g. within campus, with vendors)	$0	$0
Overall			**-$176**

Material (software vs. textbook):

- The largest cost difference between the courseware and BAU version of the course was the student subscription fee versus the textbook. College of the Canyons paid $14,000 initially to use OLI. Divided by 16 semesters (8 years) and 498 students per semester, this fee comes to $2 per student. Students in the BAU condition purchased a textbook for $180, so the savings was $178.

Stanford OLI in College of the Canyons Mathematics 140 *(cont'd.)*

Equipment (e.g. classroom renovation, computers):

- Students used their own laptops so there were no associated computer costs. No facilities costs were incurred specifically for use of OLI at College of the Canyons since computer labs and other online learning resources were already available.

Instructor professional development and training (including TAs):

- Trainings for OLI were provided to administrators and teaching staff using OLI. Customizing the course to the OLI product also involved instructor time.

Cost Effectiveness

Implementation of OLI at College of the Canyons in fall 2016 lowered costs and provided better academic results compared to business as usual in the same term.

Smart Sparrow in Mohave Community College Biology 100

- Term: Fall 2016
- Course: BIO 100
- Number of students considered in the cost effectiveness analysis: 106
- Business as Usual (BAU) Comparison: Lecture course with textbook in fall 2016
- Impact estimate for effect on course grade: 0.22
- Average section sizes: 37 treatment, 22 BAU

Cost Components

Analysis Level	Cost Element	Cost Difference/ Institution	Cost Difference/ Student
Student-level	Material (software vs. textbook)		-$65
Instructor-level	Equipment (e.g. classroom renovation, computers)	$0	0
	Instructional design (e.g. instructor labor, instructional design staff)	$17	0
	Instructor professional development and training (including TAs)	$126	1
	Teaching time difference (e.g. preparation, instructional time, grading)	$705	7
	Other campus staff (e.g. technical/administrative support)	$0	0
	Communication (e.g. within campus, with vendors)	$660	6
Overall			**-$51**

Material (software vs. textbook):

- The largest cost difference between the courseware and BAU version of the course was the student subscription fee versus the textbook. This created a savings of $65 per student.

Equipment (e.g. classroom renovation, computers):

- Students used their own laptops so there were no associated computer costs. No facilities costs were incurred specifically for use of Smart Sparrow at Mohave Community College since computer labs and other online learning resources were already available.

Smart Sparrow in Mohave Community College Biology 100 *(cont'd.)*

Instructional design (e.g. instructor labor, instructional design staff):

- Additional money was spent in the time invested by administrators and other college faculty related to the course reconstruction initially.
- Increased instructor time included the work of redesigning the homework assignments used in the course, faculty training for Smart Sparrow, and time spent answering student questions and helping students use the product.

Instructor professional development and training (including TAs):

- Trainings for Smart Sparrow were provided to administrators and teaching staff using the product, as well as ongoing training and coaching.

Communication (e.g. within campus, with vendors):

- Time was spent by college staff in communication regarding the NGC project, such as course design and data collection.

Cost Effectiveness

Implementation of Smart Sparrow at Mohave Community College in fall 2016 lowered costs and provided better academic results compared to business as usual in the same term.

Smart Sparrow in National University Biology 100

- Term: Fall 2016
- Course: BIO 100
- Number of students considered in the cost effectiveness analysis: 200
- Business as Usual (BAU) Comparison: Lecture course with LaunchPad in fall 2016
- Impact estimate for effect on course grade: 0.17
- Average section sizes: 23 treatment, 22 BAU

Cost Components

Analysis Level	Cost Element	Cost Difference/ Institution	Cost Difference/ Student
Student-level	Material (software vs. textbook)		-$65
Instructor-level	Equipment (e.g. classroom renovation, computers)	$0	$0
	Instructional design (e.g. instructor labor, instructional design staff)	$0	$0
	Instructor professional development and training (including TAs)	$5,560	$28
	Teaching time difference (e.g. preparation, instructional time, grading)	-$1,096	-$5
	Other campus staff (e.g. technical/administrative support)	$0	$0
	Communication (e.g. within campus, with vendors)	$1,240	$6
Overall			**-$36**

Material (software vs. textbook):

- The largest cost difference between the courseware and BAU version of the course was the student subscription fee associated with Smart Sparrow in relation to the BAU product, LaunchPad. This provided a savings of $65 per student.

Equipment (e.g. classroom renovation, computers):

- Students were required to bring their own laptops so there were no associated computer costs. No facilities costs were incurred specifically for use of Smart Sparrow or LaunchPad since computer labs and other online learning resources were already available.

Smart Sparrow in National University Biology 100 *(cont'd.)*

Instructor professional development and training (including TAs):

- For the Smart Sparrow treatment condition, faculty were provided training and incentives to use the product.

Teaching time difference (e.g. preparation, instructional time, grading):

- Faculty teaching the BAU condition using LaunchPad spent time creating videos for that product. Smart Sparrow, for the treatment condition, did all the customization for National University, providing a savings in the first year of implementation.

Communication (e.g. within campus, with vendors):

- Time was spent by university staff in communication regarding the NGC project, inlcuding as course design and data collection.

Cost Effectiveness

Implementation of Smart Sparrow at National University in fall 2016 lowered costs and provided better academic results compared to business as usual in the same term.

Implications and Recommendations

As a large, complex initiative, the Next Generation Courseware Challenge generated a great deal of data and valuable experience to support future efforts to leverage learning technology to close college attainment gaps. We close this report by highlighting six themes with implications for future efforts.

When well-implemented, adaptive, next-generation courseware appears to be at least as effective as business as usual and to hold particular promise for enhancing course outcomes for under-represented students.

Across all 28 NGCC impact studies, the average courseware impact on course grades was significantly positive but small in magnitude. More encouraging were the findings of analyses of courseware impacts for students from ethnic groups under-represented among college graduates. The average impact estimate for the ten datasets that could be used to evaluate the impact of NGCC courseware on under-represented minority students was larger than that for students as a whole, and half of those courseware implementations resulted in statistically significant positive impacts for under-represented minorities.

But much remains to be learned about how incorporating courseware into a lower-division college course affects the experiences of under-represented students, suggesting the need for qualitative and longitudinal studies to complement analyses of course performance data. **This research should include in-depth studies of the study behaviors and experiences of students from low-income and under-represented backgrounds in gateway courses with and without adaptive courseware.**

A better understanding of these students' needs and experiences would inform technology developers' continuing efforts to improve their courseware products and guidelines for implementing them.

Efforts to scale courseware through institutional adoptions may sacrifice user numbers in the short term, but have advantages in the longer term. NGCC scaling data suggest that it may take three years for the institutional scaling strategy to attain parity with the direct-to-faculty strategy in terms of user numbers. But what these numbers do not reveal is the greater capacity for department-wide course redesign and for measuring courseware impacts in institutions that are undergoing wholesale adoption. To the extent that courseware is intended to be a stimulus for significant changes in college programs and pathways, institutional adoptions (at least program or department-wide) are preferable. Institutional adoptions are more likely to have support from institutional leaders who can articulate a vision for using courseware to improve teaching and learning and to provide resources and incentives (such as faculty recognition or stipends) to support the effort. They also make it possible to

conduct more useful analyses of the impacts of course changes. As part of an institutional adoption, common learning outcomes can be defined and assessed across all sections of a course. It is also more likely that student information system data will be made available that can be combined with course behavior and outcome data in controlled studies of course redesign impacts. At the same time, experience suggests that for initial trials of new courseware products and teaching approaches, there are advantages in working with volunteer instructors. In addition to being easier to recruit (because there are so many more of them and only one person has to be convinced), individual instructors who are interested in trying out new pedagogies supported by courseware are more likely to use the courseware to the extent intended and to make connections between online and face-to-face components of their course.

On balance, the NGCC experience suggests that providers of new courseware products may wish to work with individual volunteer instructors during the early trials of their product as they are collecting feedback that will help them improve the product and exploring different courseware implementation models. Once the product has achieved greater stability and implementation models that appear to work well have been articulated, it makes sense to move toward efforts at institutional adoption. Similarly, from the institutional perspective, most colleges would not want to discourage individual faculty members from trying out new digital learning tools they identify themselves, provided that the tools are accessible to all students and compatible with the campus IT infrastructure. But if **courseware adoption is intended to be a stimulus for significant improvements in student outcomes, institutional adoptions (at least program or department-wide) will be needed.**

Many questions remain about the conditions and practices necessary for next-generation courseware to enhance student outcomes in community college settings. A particular concern in the NGCC student impact data is the lack of positive findings for implementations within community colleges. We know both from some of the NGCC community college impact studies and from past efforts to bring digital learning to this market (see Means, Peters, & Zheng, 2014) that courseware can improve student outcomes in community college courses, but clearly it does not do so consistently. The low number of community college courseware implementations with positive impacts on student course outcomes suggests that these institutions have not developed some of the organizational capacities and processes used in four-year colleges. At the same time, it should be recognized that community colleges are serving a different population and often do so primarily with part-time instructors. There is a need to develop models for growing the capacity to improve teaching and learning within community colleges and to document "proof of concept" cases from which other community colleges can learn.

Most institutions implementing next-generation courseware experienced extra costs for the first round of implementation, but the incremental costs to the institution were typically modest and outweighed by savings experienced by students. Additional costs to institutions stemmed largely from instructors spending time learning to use the courseware product and planning its integration into their teaching. There were also modest costs for activities such as providing instructor training or IT support and time communicating with the courseware vendor. Most of these costs did not involve actual expenditures on the part of institutions, but rather the value of the additional staff time

required. The institutions in our nine NGCC cost studies did not attempt to save costs by increasing class size or reducing the number of contact hours when they started using courseware. These biggest cost savings found in our nine cases resulted from savings on textbook costs. An insight we gained from the process of collecting and analyzing cost data was that this is very difficult to do in cases where the comparison version of the course was taught years earlier. Instructors for those course implementations are likely to be gone or, even if they are still at the institution, to be unable to remember the amount of time they spent on various course preparation and delivery activities. The burden of providing good data about the expenditure of time and other cost elements would be reduced if the data were collected each time the course is offered using a common digital reporting template. If higher education institutions used such a template as a regular practice, cost data would likely be not only more complete but also more accurate. Having the cost information for different versions of a course, institutions could combine that information with data on the number of successful student outcomes achieved by each version of the course to arrive at a cost-effectiveness measure. Even educators who bristle at institutional efforts to reduce costs can see the logic of examining cost effectiveness.

More direct engagement between researchers and higher education institutions appears necessary both to improve the quality of impact evidence and to enhance organizational capacity. Neither technology developers nor higher education institutions by themselves are likely to generate objective evidence of courseware impacts under normal conditions. Collaborations among higher education institutions, learning technology providers, and researchers will be needed to generate a sound base of evidence concerning impacts and best practices. Moreover, research-practice partnerships pairing researchers and higher education institutions could help the latter organizations build expectations and staff capacity around doing appropriately rigorous course redesign impact evaluations.

At the same time, any funder of social programs faces the trade-off between funding more services and funding more rigorous evaluations of the impact of those services. Finding more cost-effective ways to gather rigorous evidence at scale is an ongoing challenge. The foundation and SRI have made several attempts to reduce evaluation costs by developing processes and data templates that could be used by either higher education institutions themselves (as in the Yarnall, Means, and Wetzel evaluation of the Advanced Learning Market Acceleration Project) or the technology developer/distributor (as in NGCC) with a limited amount of direct researcher support. Neither approach has proven fully successful. **Ideally, participating colleges and universities would embrace the goal of doing evidence-based decision-making around course redesign/courseware adoption at the same time they embrace digital learning.** By working closely with educational institutions in the early phases of this work, evaluators could get better data and co-design sustainable evaluation practices with college staff. This approach may be tried out as part of the Adaptive Courseware for Early Success strategy of the Every Learner Everywhere Network.

Courseware impact evaluations need to broaden their to encompass longer-term impacts including degree attainment as well as course-level outcomes. The foundation has amassed course outcome data for scores of courseware implementations over the last eight years. While very useful, this database by itself does not answer questions about progress against the foundation's goal

of increasing the proportion of low-income and under-represented students who attain college degrees or other marketable credentials. It is time to start looking at student progress over time by asking questions such as how students who experienced courseware in their gateway courses perform relative to those receiving more conventional instruction in future courses in their major or pathway. Only by conducting longitudinal studies of course performance, credit accumulation, retention and completion over time can we understand whether or not investments in digital learning are having the intended payoff.

Implications for actions that courseware vendors, higher education institutions, researchers, and funders can take to respond to these findings are shown in the boxes that follow. Close collaboration between all of these sectors will be necessary to produce significant and consistent improvements in the learning experiences and educational attainments of low-income and under-represented minority college students.

For Courseware Vendors:

- Following the example of NGCC grantees, courseware vendors should work closely with early users of their products and plan for product refinement cycles that can be informed by data from alpha and beta product users.
- Product efficacy claims should be stated cautiously and should acknowledge the importance of implementation factors and aspects of teaching and learning other than the courseware.
- Courseware vendors could benefit from finding external research partners to help them design and execute rigorous studies of product implementation and effectiveness.

For Higher Education Institutions:

- Colleges and universities should take responsibility for generating impact estimates--based on comparisons controlling for key student characteristics and prior achievement--for their course redesign efforts, including but not limited to those incorporating courseware.
- To become evidence-driven with respect to their teaching and learning approaches, colleges and universities would do well to have a highly placed "champion" responsible for promoting course improvement efforts and impact evaluations.
- Course behaviors and outcomes should be measured at multiple time scales (during the course, end-of-course, and over multiple academic terms) both for students overall and for key student subgroups (e.g., low-income students, under-represented minority students).
- Higher education institutions should evaluate their large-scale adoptions of next-generation courseware in terms of cost effectiveness (i.e., cost per desired student outcome) rather than cost reduction per se.

For Researchers and Evaluators:

- Researchers should work closely with course designers to define and collect data on early indicators of likely course success.
- Researchers should be advocates for stronger course evaluation designs, featuring random assignment of students to different versions of the course where possible or statistical controls for student characteristics and prior achievement at a minimum.
- Courseware impact studies should expand their focus to encompass longer-term student outcomes, including persistence and degree attainment, as well as course grades and credits.
- Researchers should help their higher education and courseware vendor collaborators understand that expected large samples of students using a particular learning technology can become small when analyses apply appropriate controls for student characteristics.

For Funders:

- The field would benefit from an evidence-driven deeper dive into the influences of instructor quality, instructional practices, student and instructor supports, and students' own behaviors and perspectives when courseware is introduced.
- Obtaining evidence on the impacts of courseware implementation at scale may require supporting higher education institutions in organizational change around the use of evidence as a key to improving instruction and student outcomes.
- More direct engagement between researchers and higher education institutions appears necessary both to improve the quality of impact evidence and to enhance organizational capacity.
- The field needs research that examines longer-term impacts of courseware, such as student persistence, performance in the next course in the same pathway or subject area, and credit accumulation over time.

References

Bakia, M., Caspary, K., Wang, H., Dieterle, E., & Lee, A. (2011). *Estimating the Effects of Online Learning for Secondary School Students: State and District Case Studies.* Menlo Park, CA: SRI International.

Bowen, W.G. (2013). *Higher Education in the Digital Age.* Princeton University Press. Retrieved from http://www.jstor.org/stable/j.ctt24hrb1

Figlio, D., Rush, M., Yin, L. (2013). Is It Live or Is It Internet? Experimental estimates of the effects of online instruction on student learning. *Journal of Labor Economics, University of Chicago Press, 31*(4), 763-784.

Harris, D. (2009). Toward policy-relevant benchmarks for interpreting effect sizes: Combining effects with costs. *Educational Evaluation and Policy Analysis, 31*(1), 3- 29.

Hollands, F.M., Brooks, A., Belfield, C., Levin, H.M., Chang, H., Shand, R., Pan, Y.I., & Hanisch-Cerda, B. (2014). Cost-Effectiveness Analysis in Practice: Interventions to Improve High School Completion. *Educational Evaluation and Policy Analysis, 36*(3), 307-326.

Jaggers, S. (2011). *Online learning: Does it help low-income and underprepared students?* Retrieved from Community College Research Center, Teachers College, Columbia University.

Levin, H.M. (2001). Waiting for Godot: cost: effectiveness analysis in education. *New directions for evaluation, 2001*(90), 55-68.

Levin, H.M. (1975). Cost-effectiveness analysis in evaluation research. *Handbook of evaluation research, 2,* 89-122.

Levin, H.M., McEwan, P.J., Belfield, C., Bowden, A.B., & Shand, R. (2017). *Economic Evaluation in Education: Cost-Effectiveness and Benefit-Cost Analysis (3rd ed.)*. Thousand Oaks, CA: Sage Publications.

Means, B., Bakia, M., Murphy, R. (2014). *Learning online: What research tells us about whether, when and how.* New York, NY: Routledge.

Means, B., Murphy, R., & Shear, L. (2017). *Pearson | SRI Series on Building Efficacy in Learning Technologies. Vol. 1 Understand, Implement & Evaluate.* London: Pearson.

Means, B., Peters, V., & Zheng, Y. (2014). *Lessons from Five Years of Funding Digital Courseware: Postsecondary Success Portfolio Review.* Menlo Park, CA: SRI Education.

Means, B., Toyama, Y., & Murphy, R., Bakia, M., & Jones, K. (2010). *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies.* U.S. Department of Education, Office of Planning, Evaluation, and Policy Development. Washington, D.C.

Tyton Partners (2014). *Time for Class: Lessons for the Future of Digital Courseware in Higher Education.* Available at: http://tytonpartners.com/library/time-for-class-lessons-for-the-future-of-digital-courseware-in-higher-education/.

Appendices

A. Number of Students Using Courseware Products by Academic Term

B. Instructor Survey Data

C. Impact Estimation Methods

D. Meta-analysis Methods

E. Cost and Cost Effectiveness Study Methods

Appendix A: Number of Students Using Courseware Products by Academic Term

Table A-1. Number of Students Using Courseware Products by Academic Term

	Spr/Sum 2015	Fall 2015	Spr/Sum 2016	Fall 2016	Spr/Sum 2017	Fall 2017	TOTAL
Acrobatiq	-	-	315	11,992	27,702	8,288	48,297
Cerego[1]	-	1,550	1,329	1,005	361	-	4,245
CogBooks	-	559	464	959	560	-	2,542
Lumen Learning	-	1,824	3,902	2,521	-	-	8,247
OpenStax	-	-	14,316	10,372	5,759	653	31,100
Smart Sparrow	728	855	1,389	1,423	1,186	-	5,581
Stanford	7,017	4,594	7,196	5,883	6,888	6,241	37,819
TOTAL*	**7,745**	**9,382**	**28,911**	**34,155**	**42,456**	**15,182**	**137,831**

1 Cerego declined to provide enrollment data for AY 2016-17.

Appendix B: Instructor Survey Data

Table B-1. Aggregate (*n*=550, 78% Response Rate)

Q#	Question Text	n	Mean	SD
1	Are you currently using PRODUCT in any of your courses?	362	1.00	0.00
3a	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	402	0.92	0.27
	36-99	17	0.04	0.19
	100-249	3	0.01	0.08
	250-499	4	0.01	0.10
	500 or more	11	0.03	0.16
3b	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	68	0.93	0.25
	36-99	3	0.04	0.20
	100-249	1	0.01	0.12
	250-499	1	0.01	0.12
	500 or more	0		
3c	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	24	0.92	0.27
	36-99	2	0.08	0.27
	100-249	0		
	250-499	0		
	500 or more	0		
3d	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	10	0.91	0.30
	36-99	1	0.09	0.30
	100-249	0		
	250-499	0		
	500 or more	0		
3e	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	6	0.86	0.38
	36-99	1	0.14	0.38
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-1. Aggregate (*n*=550, 78% Response Rate) (cont'd.)

Q#	Question Text	n	Mean	SD
3f	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	3	.75	.50
	100-249	0		
	250-499	0		
	500 or more	0		
3g	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3h	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3i	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3j	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
4	Is this your first time using PRODUCT in COURSE?			
	Is this your first time using PRODUCT in COURSE?	472	0.54	0.50
	Is this your first time using PRODUCT in COURSE?	58	0.48	0.50
	Is this your first time using PRODUCT in COURSE?	15	0.60	0.51
	Is this your first time using PRODUCT in COURSE?	4	.50	0.58
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		

Table B-1. Aggregate (*n*=550, 78% Response Rate) (cont'd.)

Q#	Question Text	n	Mean	SD
5	Have you taught this course before without using {Product}? (1=Yes)	104	0.81	0.40
5a	Did you use another courseware product previously? (1=Yes)	8	0.25	0.46
8	Did you teach this course with PRODUCT in a previous term?	180	0.5	0.50
9	For how many terms have you used PRODUCT in the past?			
	1 term	61	0.34	0.47
	2 terms	44	0.24	0.43
	3 terms	24	0.13	0.34
	4 terms	13	0.07	0.26
	5+ terms	38	0.21	0.41
10	Have you ever taught courses with online or blended learning components before using PRODUCT?	472	0.67	0.47
11	"Last Fall, were you teaching…" (1=Yes, Full time)	405	0.73	0.44
12	"Last Fall, was your position…"			
_1	Tenure track faculty	209	0.52	0.50
_2	Lecturer or Instructor	95	0.23	0.42
_3	Adjunct professor, lecturer, or instructor	101	0.25	0.43
13	"Did you have a choice to use {Product} for your course this term (spring 2017)?" (1=Yes)	450	0.70	0.46
14	"What motivated you to choose {Product}?" (1=Yes)			
_1	Interest in exploring online teaching and learning	314	0.72	0.45
_2	Thought {Product} would help with course management or organization	314	0.50	0.50
_3	Thought teaching with {Product} would take less of my time	314	0.22	0.42
_4	Desire for a more flexible teaching schedule	314	0.12	0.33
_5	Opportunity for professional development	314	0.39	0.49
_6	Received an attractive incentive	314	0.09	0.29
_7	This was the only online learning tool available to me for this course	314	0.09	0.29
_8	To be consistent with other courses/sections	314	0.16	0.37
_9	Desire for a more convenient way to communicate with students	314	0.26	0.44
_10	Expectation that my students would be more engaged	314	0.87	0.34
_11	Expectation that my students would receive more individualized learning	314	0.84	0.37
_12	Encouragement from upper levels of your institution (for example, your department or college) to use {Product}	314	0.19	0.39
_13	Wanted to same my students the cost of a textbook	18	0.78	0.43
_14	Other (please explain)	314	0.31	0.46

Table B-1. Aggregate (*n*=550, 78% Response Rate) (cont'd.)

Q#	Question Text	n	Mean	SD
15	"To what extent did using {Product} change the way you…" (1=Some Change or Major Change)			
_1	Planned this course	518	0.51	0.50
_2	Presented the material for this course	517	0.53	0.50
_3	Interacted with students in this course	518	0.49	0.50
_4	Evaluated students in this course	517	0.6	0.49
16	"Did you receive training or professional development this term (spring 2017) on how to use or integrate {product} into your course to improve student learning?" (1=Yes)	482	0.46	0.50
17	"How many hours of training did you receive this term?"	78	5.24	7.21
19	"How satisfied were you with the training you received this term?" (1=Moderately or Highly Satisfied)	220	0.89	0.32
20	"Was training for {Product} offered this term (spring 2017)?" (1=Yes)	258	0.31	0.46
21	"Briefly indicate your reasons for not participating in the training for {Product} this year." (1=Yes)			
_1	Training did not align with my schedule	78	0.36	0.48
_2	Training offered in inconvenient location or format	78	0.08	0.27
_3	Training took too much time	76	0.22	0.42
_4	Training occurred before I was hired	78	0.04	0.19
_5	I took the training previously	71	0.32	0.47
_6	Did not feel the need for training	184	0.25	0.43
_7	Other, please describe.	76	0.11	0.31
22	"The last time you taught your course without {Product}, did you receive any training or professional development on how to design and implement instruction to improve student learning?" (1=Yes)	52	0.38	0.49
23	"How many hours of training did you receive for your course on how to design and implement instruction and to improve student learning when not using {Product}?"	19	6.53	8.61
24	"When preparing for your course this spring, how much time did you spend (in hours) learning how to use {Product}, in both formal training and individual preparation? Do not include any time spent learning the product before fall 2016.	463	8.37	10.00
25	"When preparing for your course this spring, how much time did you spend (in hours) integrating {Product} into your course (e. g., adapting assignments, adapting format of content or lesson delivery, adapting grading, etc.)? Do not include any time spent learning the product before fall 2016."	460	16.24	15.27
26	"How prepared did you feel to use {Product} this term (spring 2017)?" (1=Very or Adequately Prepared)	550	0.69	0.46
27	"Have you received support for using {Product} outside of formal training this term (spring 2017?" (1=Yes)	512	0.56	0.50

Table B-1. Aggregate (*n*=550, 78% Response Rate) (cont'd.)

Q#	Question Text	n	Mean	SD
28	"From which of these sources have you received support for using {Product} this term? (1=Yes)			
_1	{Product} support staff/technical assistance	286	0.85	0.36
_2	Next Generation Courseware Challenge project leader on my campus	286	0.17	0.38
_3	Peers/colleagues also using {Product}	286	0.51	0.50
_4	Technical (IT) support staff on my campus	286	0.21	0.41
_5	Instructional design staff on my campus	286	0.23	0.42
_6	Someone else from my department	286	0.22	0.42
_7	Other (please specify)	286	0.08	0.27
29	"How helpful was this support in enabling you to use {Product} in your course this term (spring 2017)"?" (1=Very Helpful or Helpful)			
_1	{Product} support staff/technical assistance	242	0.89	0.32
_2	Next Generation Courseware Challenge project leader on my campus	50	0.92	0.27
_3	Peers/colleagues also using {Product}	147	0.89	0.31
_4	Technical (IT) support staff on my campus	58	0.74	0.44
_5	Instructional design staff on my campus	65	0.94	0.24
_6	Someone else from my department	60	0.83	0.38
_7	Other (please specify)	13	0.85	0.38
30	"Which of the following best describes how {Product} is/was used in your course this term (spring 2017)?"			
	Substitute for printed text as core course component	174	0.32	0.47
	Substitute for some lecture/class meeting time	12	0.02	0.15
	Supplemental source of course content	117	0.21	0.41
	Skills practice environment	92	0.17	0.37
	Formative assessment system	28	0.05	0.22
	Flipping the classroom (i.e., using the product to cover content in advance so that class time could be used for more active activities)	48	0.09	0.28
	Fully online delivery of course	78	0.14	0.35
31	"What proportion of the content in your course is being delivered using {Product}?"			
	0% to 24%	163	0.37	0.48
	25% to 49%	85	0.19	0.40
	50% to 79%	75	0.17	0.38
	80% to 100%	116	0.26	0.44
32	"Before the start of your course this term (spring 2017), how many hours would you estimate you spent planning your instruction and student assignments?"	61	13.15	11.16

Table B-1. Aggregate (*n*=550, 78% Response Rate) (cont'd.)

Q#	Question Text	n	Mean	SD
33a	"Think about a typical week teaching your course this term (spring 2017). How many hours did you spend on each of the following course-related activities during that week?"			
	Presenting course content and leading course instruction hours	61	6.00	5.61
	Interacting with students (including office hours, email correspondence, etc.)	61	8.98	9.42
	Evaluating or providing written feedback on student work	61	5.46	5.82
	Course administration (e.g. entering grades, technology assistance, etc.)	61	4.48	3.84
	Revising your plan for instruction and student assignments	61	5.72	6.07
34	"How many hours did you spend planning instruction and student assignments before the course started for {Course} with and without using {Product}?"			
1_1	With {Product}	83	13.43	10.73
2_1	Without using {Product}	82	15.3	12.98
35	"During a typical week, how many hours did/do you spend performing the following tasks for {Course} with and without using {Product}?"			
1_1	With using {Product}: Presenting course content and leading course instruction hours	83	5.16	4.98
1_2	With using {Product}: Interacting with students (including office hours, email correspondence, etc.)	83	6.39	6.65
1_3	With using {Product}: Evaluating or providing written feedback on student work	84	4.27	3.34
1_4	With using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	83	3.73	3.08
1_5	With using {Product}: Revising your plan for instruction and student assignments	82	3.40	2.65
2_1	Without using {Product}: Presenting course content and leading course instruction hours	83	5.76	5.20
2_2	Without using {Product}: Interacting with students (including office hours, email correspondence, etc.)	83	6.06	5.75
2_3	Without using {Product}: Evaluating or providing written feedback on student work	83	4.89	4.53
2_4	Without using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	83	3.83	3.22
2_5	Without using {Product}: Revising your plan for instruction and student assignments	82	3.66	3.21
36	"Overall, how would you describe the impact of using {Product} on the time you spend on your course?" (1= Major or Minor Time Saver)	144	0.38	0.49
37	How important is the ability to print content to use PRODUCT?	68	0.56	0.50
38	Who pays for printing?			
	College pays for printing	17	0.45	0.50
	Students pays for printing	16	0.42	0.50
	Other pays for printing	5	0.13	0.34
39	Approximately how many pages per student are printed over the entire course?			
	0-50 pages	15	0.63	0.49
	51-100 pages	2	0.08	0.28
	101-150 pages	3	0.13	0.34
	151-200 pages	1	0.04	0.20
	200+ pages	3	0.13	0.34

Table B-1. Aggregate (*n*=550, 78% Response Rate) (cont'd.)

Q#	Question Text	n	Mean	SD
40	"When your course is taught at your institution without {Product}, are textbooks or other materials generally required or recommended for students?" (1=Yes)	143	0.85	0.36
41	"What is the approximate cost of text and other materials for your course when teaching it without {Product}?" (1=Less than $25, 7=More than $275)			
	Less than $25	18	0.15	0.36
	$26-$75	11	0.09	0.29
	$76-$125	30	0.25	0.44
	$126-$175	17	0.14	0.35
	$176-$225	29	0.25	0.43
	$226-$275	5	0.04	0.20
	More than $275	3	0.03	0.16
	Don't know	5	0.04	0.20
42	"Is your course staffed differently when using {Product}?"			
_1	Yes, more staff	23	0.17	0.37
_2	Yes, less staff	11	0.08	0.27
_3	No, same staff	97	0.70	0.46
_4	Don't Know	7	0.05	0.22
43	"How frequently do you use each of the following instructor-oriented features of {Product}?" (1=Used All or Some of the Time)			
_1	Used online gradebook to keep track of individual students' performance	528	0.67	0.47
_2	Used dashboards to track progress of the class as a whole	535	0.49	0.50
_3	Used dashboard to check individual students' progress in understanding concepts and content	532	0.52	0.50
_4	Used dashboard to check when individual students last logged in to {Product}	529	0.33	0.47
_5	Used {Product} student performance data to refer individual students to specific content or problem activities	533	0.32	0.47
_6	Adjusted the structure or sequencing of course content in {Product} for some students	522	0.17	0.37
_7	Used {Product} to communicate with students	520	0.22	0.42
_8	Used {Product} to make class materials available to students	520	0.47	0.50
_9	Identifying common misconceptions so that I could address them during class time	530	0.34	0.47

Table B-1. Aggregate (*n*=550, 78% Response Rate) (cont'd.)

Q#	Question Text	n	Mean	SD
44	"How much do you agree or disagree with the following statements? Using {Product} helps students…" (1=Strongly Agree or Agree)			
_1	Better understand and remember course content	546	0.66	0.47
_2	Better analyze and apply course content	546	0.62	0.49
_3	Complete more complex assignments that demonstrate their understanding of course content	543	0.48	0.50
_4	Stay more engaged in the course	546	0.64	0.48
_5	Reduce costs associated with the course (e.g., purchasing a textbook)	543	0.42	0.49
_6	Interact more with me around course content	436	0.78	0.42
_7	Interact more with other students around course content	545	0.34	0.47
_8	Other (please explain)	68	0.46	0.50
45	"How much do you agree or disagree with the following statements regarding {Product}? Using {Product} in this course helped me…" (1=Strongly Agree or Agree)			
_1	Present content more effectively	545	0.52	0.50
_2	Personalize learning in response to different students' needs	542	0.48	0.50
_3	Reduce time spent assessing student learning	547	0.41	0.49
_4	Reduce the time spent on mechanical teaching tasks such as recording grades	545	0.35	0.48
_5	Reduce time spent in class	539	0.21	0.41
_6	Better monitor individual student progress	548	0.57	0.50
_7	Keep better track of whole-class progress	546	0.53	0.50
_8	Increase student engagement with the content of my course	545	0.63	0.48
_9	Use class time for more interactive activities	541	0.47	0.50
_10	Reduce time spent preparing the course at the start of the term	433	0.24	0.43
_11	Support my students in deeper learning	546	0.63	0.48
_12	Other	98	0.58	0.50
46	"Did you experience any usability and technical problems when using {Product} in your course this term (spring 2017)?" (1=Yes)	516	0.56	0.50
47	"Which of these usability and technical problems did you experience when using {Product} in your course this term?" (1=Yes)			
_1	Problems with logging or signing in (either you or your students)	289	0.55	0.50
_2	Incompatibilities with existing computer hardware or software (e.g., browser incompatibilities)	289	0.47	0.50
_3	Incompatibilities with our campus systems, such as the Learning Management or Student Information System	289	0.27	0.45
_4	Incompatibilities with other online resources	289	0.12	0.33
_5	Lack of technical or help desk support needed from my campus	289	0.19	0.40
_6	Lack of technical or help desk support needed from {Grantee}	289	0.20	0.40
_7	Confusing design of dashboard or system interface	289	0.44	0.50
_8	Other	284	0.42	0.49

Table B-1. Aggregate (*n*=550, 78% Response Rate) (cont'd.)

Q#	Question Text	n	Mean	SD
48	"Which, if any, of these problems did you experience when using {Product} in your course this term (spring 2017)?" (1=Yes)			
_1	Lack of alignment with course goals	507	0.19	0.39
_2	Time required to learn new online system	507	0.27	0.44
_3	Student resistance to using system	507	0.42	0.49
_4	Students did not use {Product} the way it was intended (i.e., attempting to succeed by exploiting properties of the system rather than learning the material)	507	0.39	0.49
_5	Did not work well within course schedule or allotted class time	507	0.09	0.29
_6	Other, please explain	404	0.16	0.36
_7	None of these	389	0.06	0.25
49	"Overall, how satisfied have you been when using {Product} in your course this term (spring 2017)?" (1=Highly or Moderately Satisfied)	548	0.88	0.54
51	"Do you plan to use {Product} in your course again?"			
	Yes, in much the same way I used it this term	166	0.30	0.46
	Yes, but in a more limited way	227	0.42	0.49
	Yes, and to a greater extent than I used it this term	57	0.10	0.31
	No	55	0.10	0.30
	Not sure	40	0.07	0.26
52	"How likely are you to recommend {Product} to a friend or colleague teaching the same course you do?" (0 to 10)	544	6.52	2.82

Table B-2. Acrobatiq, Product (*n*=32, 85% response rate)

Q#	Question Text	n	Mean	SD
1	Are you currently using PRODUCT in any of your courses?	14	1.00	0.00
3a	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	16	0.53	0.51
	36-99	1	0.03	0.18
	100-249	0	0.00	0.00
	250-499	2	0.07	0.25
	500 or more	11	0.37	0.49
3b	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0	0.00	
	36-99	0	0.00	
	100-249	0	0.00	
	250-499	1	.25	.5
	500 or more	0	0.00	

Table B-2. Acrobatiq, Product (*n*=32, 85% response rate) (cont'd..)

Q#	Question Text	n	Mean	SD
3c	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	2	1.00	
	36-99	0	0.00	
	100-249	0	0.00	
	250-499	0	0.00	
	500 or more	0	0.00	
3d	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1	
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3e	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3f	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3g	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3h	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-2. Acrobatiq, Product (*n*=32, 85% response rate) (cont'd..)

Q#	Question Text	n	Mean	SD
3i	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3j	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
4	Is this your first academic term using PRODUCT in COURSE?			
	Is this your first academic term using PRODUCT in COURSE?	14	0.36	0.50
	Is this your first academic term using PRODUCT in COURSE?	3	0.00	0.00
	Is this your first academic term using PRODUCT in COURSE?	1	0.00	
	Is this your first academic term using PRODUCT in COURSE?	1	0.00	
	Is this your first academic term using PRODUCT in COURSE?	0		
	Is this your first academic term using PRODUCT in COURSE?	0		
5	Have you taught this course before without using {Product}? (1=Yes)	18	0.28	0.46
5a	Did you use another courseware product previously? (1=Yes)	0	0.00	0.00
8	Did you teach this course with PRODUCT in a previous term?	10	0.71	0.47
9	For how many terms have you used PRODUCT in the past?			
	1 term	1	0.10	0.32
	2 terms	1	0.10	0.32
	3 terms	1	0.10	0.32
	4 terms	3	0.30	0.48
	5+ terms	4	0.40	0.52
10	Have you ever taught courses with online or blended learning components before using PRODUCT?	14	0.57	0.51
11	"Last Fall, were you teaching…" (1=Yes, Full time)	32	.78	0.42
12	"Last Fall, was your position…"			
_1	Tenure track faculty	7	0.22	0.42
_2	Lecturer or Instructor	19	0.59	0.50
_3	Adjunct professor, lecturer, or instructor	6	0.19	0.40

Table B-2. Acrobatiq, Product (*n*=32, 85% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
13	"Did you have a choice to use {Product} for your course this term (spring 2017)?" (1=Yes)	32	0.22	0.42
14	"What motivated you to choose {Product}?" (1=Yes)			
_1	Interest in exploring online teaching and learning	7	0.71	0.49
_2	Thought {Product} would help with course management or organization	7	0.71	0.49
_3	Thought teaching with {Product} would take less of my time	7	0.43	0.53
_4	Desire for a more flexible teaching schedule	7	0.29	0.49
_5	Opportunity for professional development	7	0.43	0.53
_6	Received an attractive incentive	7	0.00	0.00
_7	This was the only online learning tool available to me for this course	7	0.14	0.38
_8	To be consistent with other courses/sections	7	0.14	0.38
_9	Desire for a more convenient way to communicate with students	7	0.43	0.53
_10	Expectation that my students would be more engaged	7	1.00	0.00
_11	Expectation that my students would receive more individualized learning	7	1.00	0.00
_12	Encouragement from upper levels of your institution (for example, your department or college) to use {Product}	7	0.14	0.38
_13	Wanted to same my students the cost of a textbook	7		
_14	Other (please explain)	7	0.29	0.49
15	"To what extent did using {Product} change the way you…" (1=Some Change or Major Change)			
_1	Planned this course	32	0.56	0.50
_2	Presented the material for this course	32	0.59	0.50
_3	Interacted with students in this course	32	0.53	0.51
_4	Evaluated students in this course	32	0.41	0.50
16	"Did you receive training or professional development this term (spring 2017) on how to use or integrate {product} into your course to improve student learning?" (1=Yes)	32	0.44	0.50
17	"How many hours of training did you receive this term?"	11	5.91	11.43
19	"How satisfied were you with the training you received this term?" (1=Moderately or Highly Satisfied)	14	0.79	0.43
20	"Was training for {Product} offered this term (spring 2017)?" (1=Yes)	18	0.33	0.49
21	"Briefly indicate your reasons for not participating in the training for {Product} this year." (1=Yes)			
_1	Training did not align with my schedule	6	0.33	0.52
_2	Training offered in inconvenient location or format	6	0.00	0.00
_3	Training took too much time	6	0.33	0.52
_4	Training occurred before I was hired	6	0.00	0.00
_5	I took the training previously	6	0.17	0.41
_6	Did not feel the need for training	6	0.67	0.52
_7	Other, please describe.	6	0.00	0.00

Table B-2. Acrobatiq, Product (*n*=32, 85% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
22	"The last time you taught your course without {Product}, did you receive any training or professional development on how to design and implement instruction to improve student learning?" (1=Yes)	5	0.40	0.55
23	"How many hours of training did you receive for your course on how to design and implement instruction and to improve student learning when not using {Product}?"	2	5.50	6.36
24	"When preparing for your course this spring, how much time did you spend (in hours) learning how to use {Product}, in both formal training and individual preparation? Do not include any time spent learning the product before fall 2016.	26	8.31	12.95
25	"When preparing for your course this spring, how much time did you spend (in hours) integrating {Product} into your course (e. g., adapting assignments, adapting format of content or lesson delivery, adapting grading, etc.)? Do not include any time spent learning the product before fall 2016."	27	9.59	13.80
26	"How prepared did you feel to use {Product} this term (spring 2017)?" (1=Very or Adequately Prepared)	32	0.84	0.37
27	"Have you received support for using {Product} outside of formal training this term (spring 2017?" (1=Yes)	32	0.59	0.50
28	"From which of these sources have you received support for using {Product} this term? (1=Yes)			
_1	{Product} support staff/technical assistance	19	0.53	0.51
_2	Next Generation Courseware Challenge project leader on my campus	19	0.00	0.00
_3	Peers/colleagues also using {Product}	19	0.68	0.48
_4	Technical (IT) support staff on my campus	19	0.26	0.45
_5	Instructional design staff on my campus	19	0.42	0.51
_6	Someone else from my department	19	0.21	0.42
_7	Other (please specify)	19	0.11	0.32
29	"How helpful was this support in enabling you to use {Product} in your course this term (spring 2017)"?" (1=Very Helpful or Helpful)			
_1	{Product} support staff/technical assistance	10	0.70	0.48
_2	Next Generation Courseware Challenge project leader on my campus	0		
_3	Peers/colleagues also using {Product}	13	1.00	0.00
_4	Technical (IT) support staff on my campus	5	0.60	0.55
_5	Instructional design staff on my campus	8	1.00	0.00
_6	Someone else from my department	4	1.00	0.00
_7	Other (please specify)	2	1.00	0.00
30	"Which of the following best describes how {Product} is/was used in your course this term (spring 2017)?"			
	Substitute for printed text as core course component	18	0.56	0.50
	Substitute for some lecture/class meeting time	0	0.00	0.00
	Supplemental source of course content	0	0.00	0.00
	Skills practice environment	1	0.03	0.18
	Formative assessment system	0	0.00	0.00
	Flipping the classroom (i.e., using the product to cover content in advance so that class time could be used for more active activities)	4	0.13	0.34
	Fully online delivery of course	9	0.28	0.46

Table B-2. Acrobatiq, Product (*n*=32, 85% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
31	"What proportion of the content in your course is being delivered using {Product}?"			
	0% to 24%	0	0.00	0.00
	25% to 49%	7	0.22	0.42
	50% to 79%	5	0.16	0.37
	80% to 100%	20	0.63	0.49
32	"Before the start of your course this term (spring 2017), how many hours would you estimate you spent planning your instruction and student assignments?"	13	13.08	14.16
33a	"Think about a typical week teaching your course this term (spring 2017). How many hours did you spend on each of the following course-related activities during that week?"			
	Presenting course content and leading course instruction hours	13	6.08	10.78
	Interacting with students (including office hours, email correspondence, etc.)	13	17.62	15.22
	Evaluating or providing written feedback on student work	13	10.15	11.28
	Course administration (e.g. entering grades, technology assistance, etc.)	13	2.54	1.98
	Revising your plan for instruction and student assignments	13	5.46	11.15
34	"How many hours did you spend planning instruction and student assignments before the course started for {Course} with and without using {Product}?"			
1_1	With {Product}	5	5.80	5.02
2_1	Without using {Product}	5	12.60	16.88
35	"During a typical week, how many hours did/do you spend performing the following tasks for {Course} with and without using {Product}?"			
1_1	With using {Product}: Presenting course content and leading course instruction hours	5	3.80	0.84
1_2	With using {Product}: Interacting with students (including office hours, email correspondence, etc.)	5	15.60	10.53
1_3	With using {Product}: Evaluating or providing written feedback on student work	5	3.00	3.39
1_4	With using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	5	2.60	1.14
1_5	With using {Product}: Revising your plan for instruction and student assignments	5	2.60	1.34
2_1	Without using {Product}: Presenting course content and leading course instruction hours	5	5.20	2.77
2_2	Without using {Product}: Interacting with students (including office hours, email correspondence, etc.)	5	13.60	11.99
2_3	Without using {Product}: Evaluating or providing written feedback on student work	5	3.80	3.56
2_4	Without using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	5	3.40	1.82
2_5	Without using {Product}: Revising your plan for instruction and student assignments	5	3.80	1.79
36	"Overall, how would you describe the impact of using {Product} on the time you spend on your course?" (1= Major or Minor Time Saver)	18	0.17	0.38
37	How important is the ability to print content to use PRODUCT?	0		

Table B-2. Acrobatiq, Product (*n*=32, 85% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
38	Who pays for printing?			
	College pays for printing	0		
	Students pays for printing	0		
	Other pays for printing	0		
39	Approximately how many pages per student are printed over the entire course?			
	0-50 pages	0		
	51-100 pages	0		
	101-150 pages	0		
	151-200 pages	0		
	200+ pages	0		
40	"When your course is taught at your institution without {Product}, are textbooks or other materials generally required or recommended for students?" (1=Yes)	18	0.44	0.51
41	"What is the approximate cost of text and other materials for your course when teaching it without {Product}?" (1=Less than $25, 7=More than $275)			
	Less than $25	3	0.38	0.52
	$26-$75	1	0.13	0.35
	$76-$125	0	0.00	0.00
	$126-$175	0	0.00	0.00
	$176-$225	0	0.00	0.00
	$226-$275	0	0.00	0.00
	More than $275	0	0.00	0.00
	Don't know	4	0.50	0.53
42	"Is your course staffed differently when using {Product}?"			
_1	Yes, more staff	2	.11	.32
_2	Yes, less staff	0	0.00	0.00
_3	No, same staff	13	.72	.46
_4	Don't Know	3	0.17	0.38
43	"How frequently do you use each of the following instructor-oriented features of {Product}?" (1=Used All or Some of the Time)			
_1	Used online gradebook to keep track of individual students' performance	32	0.44	0.50
_2	Used dashboards to track progress of the class as a whole	32	0.34	0.48
_3	Used dashboard to check individual students' progress in understanding concepts and content	31	0.42	0.50
_4	Used dashboard to check when individual students last logged in to {Product}	32	0.44	0.50
_5	Used {Product} student performance data to refer individual students to specific content or problem activities	32	0.31	0.47
_6	Adjusted the structure or sequencing of course content in {Product} for some students	31	0.13	0.34
_7	Used {Product} to communicate with students	31	0.13	0.34
_8	Used {Product} to make class materials available to students	32	0.44	0.50
_9	Identifying common misconceptions so that I could address them during class time	32	0.38	0.49

Table B-2. Acrobatiq, Product (*n*=32, 85% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
44	"How much do you agree or disagree with the following statements? Using {Product} helps students…" (1=Strongly Agree or Agree)			
_1	Better understand and remember course content	31	0.61	0.50
_2	Better analyze and apply course content	31	0.55	0.51
_3	Complete more complex assignments that demonstrate their understanding of course content	31	0.23	0.43
_4	Stay more engaged in the course	31	0.52	0.51
_5	Reduce costs associated with the course (e.g., purchasing a textbook)	31	0.35	0.49
_6	Interact more with me around course content	31	0.61	0.50
_7	Interact more with other students around course content	31	0.29	0.46
_8	Other (please explain)	5	0.60	0.55
45	"How much do you agree or disagree with the following statements regarding {Product}? Using {Product} in this course helped me..." (1=Strongly Agree or Agree)			
_1	Present content more effectively	31	0.55	0.51
_2	Personalize learning in response to different students' needs	30	0.33	0.48
_3	Reduce time spent assessing student learning	31	0.32	0.48
_4	Reduce the time spent on mechanical teaching tasks such as recording grades	30	0.27	0.45
_5	Reduce time spent in class	29	0.21	0.41
_6	Better monitor individual student progress	31	0.35	0.49
_7	Keep better track of whole-class progress	30	0.37	0.49
_8	Increase student engagement with the content of my course	30	0.53	0.51
_9	Use class time for more interactive activities	30	0.30	0.47
_10	Reduce time spent preparing the course at the start of the term	30	0.23	0.43
_11	Support my students in deeper learning	31	0.35	0.49
_12	Other	3	0.33	0.58
46	"Did you experience any usability and technical problems when using {Product} in your course this term (spring 2017)?" (1=Yes)	32	0.63	0.49
47	"Which of these usability and technical problems did you experience when using {Product} in your course this term?" (1=Yes)			
_1	Problems with logging or signing in (either you or your students)	20	0.45	0.51
_2	Incompatibilities with existing computer hardware or software (e.g., browser incompatibilities)	20	0.25	0.44
_3	Incompatibilities with our campus systems, such as the Learning Management or Student Information System	20	0.35	0.49
_4	Incompatibilities with other online resources	20	0.15	0.37
_5	Lack of technical or help desk support needed from my campus	20	0.10	0.31
_6	Lack of technical or help desk support needed from {Grantee}	20	0.40	0.50
_7	Confusing design of dashboard or system interface	20	0.35	0.49
_8	Other	20	0.30	0.47

Table B-2. Acrobatiq, Product (*n*=32, 85% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
48	"Which, if any, of these problems did you experience when using {Product} in your course this term (spring 2017)?" (1=Yes)			
_1	Lack of alignment with course goals	31	0.16	0.37
_2	Time required to learn new online system	31	0.13	0.34
_3	Student resistance to using system	31	0.29	0.46
_4	Students did not use {Product} the way it was intended (i.e., attempting to succeed by exploiting properties of the system rather than learning the material)	31	0.35	0.49
_5	Did not work well within course schedule or allotted class time	31	0.10	0.30
_6	Other, please explain	31	0.11	0.31
_7	None of these	31	0.33	0.48
49	"Overall, how satisfied have you been when using {Product} in your course this term (spring 2017)?" (1=Highly or Moderately Satisfied)	32	0.69	0.47
51	"Do you plan to use {Product} in your course again?"			
	Yes, in much the same way I used it this term	16	0.50	0.51
	Yes, but in a more limited way	9	0.28	0.46
	Yes, and to a greater extent than I used it this term	1	0.03	0.18
	No	3	0.09	0.30
	Not sure	3	0.09	0.30
52	"How likely are you to recommend {Product} to a friend or colleague teaching the same course you do?" (0 to 10)	31	4.48	3.68

Table B-3. Cerego, Product (*n*=26, 78% response rate)

Q#	Question Text	n	Mean	SD
1	Are you currently using PRODUCT in any of your courses?	15	1.00	0.00
3a	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	15	1	
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3b	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1	
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-3. Cerego, Product (*n*=26, 78% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
3c	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3d	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3e	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3f	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3g	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3h	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-3. Cerego, Product (*n*=26, 78% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
3i	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3j	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
4	Is this your first time using PRODUCT in COURSE?			
	Is this your first time using PRODUCT in COURSE?	26	0.50	0.51
	Is this your first time using PRODUCT in COURSE?	6	0.50	0.55
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
5	Have you taught this course before without using {Product}? (1=Yes)	2	1.00	0.00
5a	Did you use another courseware product previously? (1=Yes)	0	0.00	0.00
8	Did you teach this course with PRODUCT in a previous term?	15	0.47	0.52
9	For how many terms have you used PRODUCT in the past?			
	1 term	2	0.29	0.49
	2 terms	2	0.29	0.49
	3 terms	0	0.00	0.00
	4 terms	0	0.00	0.00
	5+ terms	3	0.43	0.53
10	Have you ever taught courses with online or blended learning components before using PRODUCT?	26	0.77	0.43
11	"Last Fall, were you teaching…" (1=Yes, Full time)	15	.60	0.51
12	"Last Fall, was your position…"			
_1	Tenure track faculty	5	0.33	0.49
_2	Lecturer or Instructor	5	0.33	0.49
_3	Adjunct professor, lecturer, or instructor	5	0.33	0.49
13	"Did you have a choice to use {Product} for your course this term (spring 2017)?" (1=Yes)	18	0.83	0.38

Table B-3. Cerego, Product (n=26, 78% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
14	"What motivated you to choose {Product}?" (1=Yes)			
_1	Interest in exploring online teaching and learning	15	0.67	0.49
_2	Thought {Product} would help with course management or organization	15	0.20	0.41
_3	Thought teaching with {Product} would take less of my time	15	0.07	0.26
_4	Desire for a more flexible teaching schedule	15	0.00	0.00
_5	Opportunity for professional development	15	0.27	0.46
_6	Received an attractive incentive	15	0.40	0.51
_7	This was the only online learning tool available to me for this course	15	0.00	0.00
_8	To be consistent with other courses/sections	15	0.07	0.26
_9	Desire for a more convenient way to communicate with students	15	0.07	0.26
_10	Expectation that my students would be more engaged	15	0.87	0.35
_11	Expectation that my students would receive more individualized learning	15	0.93	0.26
_12	Encouragement from upper levels of your institution (for example, your department or college) to use {Product}	15	0.00	0.00
_13	Wanted to same my students the cost of a textbook	0		
_14	Other (please explain)	15	0.20	0.41
15	"To what extent did using {Product} change the way you…" (1=Some Change or Major Change)			
_1	Planned this course	26	0.35	0.49
_2	Presented the material for this course	26	0.23	0.43
_3	Interacted with students in this course	26	0.42	0.50
_4	Evaluated students in this course	26	0.54	0.51
16	"Did you receive training or professional development this term (spring 2017) on how to use or integrate {product} into your course to improve student learning?" (1=Yes)	18	0.56	0.51
17	"How many hours of training did you receive this term?"	3	1.67	0.58
19	"How satisfied were you with the training you received this term?" (1=Moderately or Highly Satisfied)	10	0.70	0.48
20	"Was training for {Product} offered this term (spring 2017)?" (1=Yes)	8	0.38	0.52
21	"Briefly indicate your reasons for not participating in the training for {Product} this year." (1=Yes)			
_1	Training did not align with my schedule	3	0.33	0.58
_2	Training offered in inconvenient location or format	3	0.00	0.00
_3	Training took too much time	3	0.33	0.58
_4	Training occurred before I was hired	3	0.00	0.00
_5	I took the training previously	1	0.00	
_6	Did not feel the need for training	12	0.17	0.39
_7	Other, please describe.	3	0.00	0.00

Table B-3. Cerego, Product (*n*=26, 78% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
22	"The last time you taught your course without {Product}, did you receive any training or professional development on how to design and implement instruction to improve student learning?" (1=Yes)	2	0.00	
23	"How many hours of training did you receive for your course on how to design and implement instruction and to improve student learning when not using {Product}?"	0		
24	"When preparing for your course this spring, how much time did you spend (in hours) learning how to use {Product}, in both formal training and individual preparation? Do not include any time spent learning the product before fall 2016.	24	11.83	11.90
25	"When preparing for your course this spring, how much time did you spend (in hours) integrating {Product} into your course (e. g., adapting assignments, adapting format of content or lesson delivery, adapting grading, etc.)? Do not include any time spent learning the product before fall 2016."	24	15.67	14.25
26	"How prepared did you feel to use {Product} this term (spring 2017)?" (1=Very or Adequately Prepared)	26	0.54	0.51
27	"Have you received support for using {Product} outside of formal training this term (spring 2017?" (1=Yes)	26	0.81	0.40
28	"From which of these sources have you received support for using {Product} this term? (1=Yes)			
_1	{Product} support staff/technical assistance	21	0.95	0.22
_2	Next Generation Courseware Challenge project leader on my campus	21	0.14	0.36
_3	Peers/colleagues also using {Product}	21	0.29	0.46
_4	Technical (IT) support staff on my campus	21	0.05	0.22
_5	Instructional design staff on my campus	21	0.19	0.40
_6	Someone else from my department	21	0.10	0.30
_7	Other (please specify)	21	0.00	0.00
29	"How helpful was this support in enabling you to use {Product} in your course this term (spring 2017)"?" (1=Very Helpful or Helpful)			
_1	{Product} support staff/technical assistance	20	0.85	0.37
_2	Next Generation Courseware Challenge project leader on my campus	3	1.00	0.00
_3	Peers/colleagues also using {Product}	6	1.00	0.00
_4	Technical (IT) support staff on my campus	1	1.00	
_5	Instructional design staff on my campus	4	1.00	0.00
_6	Someone else from my department	2	1.00	0.00
_7	Other (please specify)	0		
30	"Which of the following best describes how {Product} is/was used in your course this term (spring 2017)?"			
	Substitute for printed text as core course component	1	0.04	0.20
	Substitute for some lecture/class meeting time	0	0.00	0.00
	Supplemental source of course content	9	0.35	0.49
	Skills practice environment	13	0.50	0.51
	Formative assessment system	3	0.12	0.33
	Flipping the classroom (i.e., using the product to cover content in advance so that class time could be used for more active activities)	0	0.00	0.00
	Fully online delivery of course	0	0.00	0.00

Table B-3. Cerego, Product (*n*=26, 78% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
31	"What proportion of the content in your course is being delivered using {Product}?"			
	0% to 24%	14	0.93	0.26
	25% to 49%	0	0.00	0.00
	50% to 79%	0	0.00	0.00
	80% to 100%	1	0.07	0.26
32	"Before the start of your course this term (spring 2017), how many hours would you estimate you spent planning your instruction and student assignments?"	5	8.00	4.06
33a	"Think about a typical week teaching your course this term (spring 2017). How many hours did you spend on each of the following course-related activities during that week?"			
	Presenting course content and leading course instruction hours	6	5.50	1.64
	Interacting with students (including office hours, email correspondence, etc.)	6	6.67	5.39
	Evaluating or providing written feedback on student work	6	3.67	0.82
	Course administration (e.g. entering grades, technology assistance, etc.)	6	2.33	1.03
	Revising your plan for instruction and student assignments	6	6.33	5.24
34	"How many hours did you spend planning instruction and student assignments before the course started for {Course} with and without using {Product}?"			
1_1	With {Product}	2	21.00	0.00
2_1	Without using {Product}	2	16.00	7.07
35	"During a typical week, how many hours did/do you spend performing the following tasks for {Course} with and without using {Product}?"			
1_1	With using {Product}: Presenting course content and leading course instruction hours	2	4.00	0.00
1_2	With using {Product}: Interacting with students (including office hours, email correspondence, etc.)	2	6.00	4.24
1_3	With using {Product}: Evaluating or providing written feedback on student work	2	4.00	1.41
1_4	With using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	2	5.50	0.71
1_5	With using {Product}: Revising your plan for instruction and student assignments	2	3.00	1.41
2_1	Without using {Product}: Presenting course content and leading course instruction hours	2	4.00	0.00
2_2	Without using {Product}: Interacting with students (including office hours, email correspondence, etc.)	2	6.00	4.24
2_3	Without using {Product}: Evaluating or providing written feedback on student work	2	3.50	2.12
2_4	Without using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	2	5.00	0.00
2_5	Without using {Product}: Revising your plan for instruction and student assignments	2	3.00	1.41
36	"Overall, how would you describe the impact of using {Product} on the time you spend on your course?" (1= Major or Minor Time Saver)	8	0.25	0.46
37	How important is the ability to print content to use PRODUCT?	8	0.25	0.46

Table B-3. Cerego, Product (n=26, 78% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
38	Who pays for printing?			
	College pays for printing	2	1.00	0.00
	Students pays for printing	0	0.00	0.00
	Other pays for printing	0	0.00	0.00
39	Approximately how many pages per student are printed over the entire course?			
	0-50 pages	1	1.00	
	51-100 pages	0	0.00	
	101-150 pages	0	0.00	
	151-200 pages	0	0.00	
	200+ pages	0	0.00	
40	"When your course is taught at your institution without {Product}, are textbooks or other materials generally required or recommended for students?" (1=Yes)	8	1.00	0.00
41	"What is the approximate cost of text and other materials for your course when teaching it without {Product}?" (1=Less than $25, 7=More than $275)			
	Less than $25	0	0.00	0.00
	$26-$75	0	0.00	0.00
	$76-$125	1	0.13	0.35
	$126-$175	2	0.25	0.46
	$176-$225	5	0.63	0.52
	$226-$275	0	0.00	0.00
	More than $275	0	0.00	0.00
	Don't know	0	0.00	0.00
42	"Is your course staffed differently when using {Product}?"			
_1	Yes, more staff	1	0.13	0.35
_2	Yes, less staff	0	0.00	0.00
_3	No, same staff	7	0.88	0.35
_4	Don't Know	0	0.00	0.00
43	"How frequently do you use each of the following instructor-oriented features of {Product}?" (1=Used All or Some of the Time)			
_1	Used online gradebook to keep track of individual students' performance	25	0.32	0.48
_2	Used dashboards to track progress of the class as a whole	25	0.40	0.50
_3	Used dashboard to check individual students' progress in understanding concepts and content	24	0.58	0.50
_4	Used dashboard to check when individual students last logged in to {Product}	23	0.35	0.49
_5	Used {Product} student performance data to refer individual students to specific content or problem activities	25	0.16	0.37
_6	Adjusted the structure or sequencing of course content in {Product} for some students	25	0.08	0.28
_7	Used {Product} to communicate with students	24	0.08	0.28
_8	Used {Product} to make class materials available to students	25	0.16	0.37
_9	Identifying common misconceptions so that I could address them during class time	24	0.13	0.34

Table B-3. Cerego, Product (*n*=26, 78% response rate) (cont'd.)

Q#	Question Text	n	Mean	SD
44	"How much do you agree or disagree with the following statements? Using {Product} helps students…" (1=Strongly Agree or Agree)			
_1	Better understand and remember course content	25	0.80	0.41
_2	Better analyze and apply course content	25	0.60	0.50
_3	Complete more complex assignments that demonstrate their understanding of course content	25	0.44	0.51
_4	Stay more engaged in the course	25	0.72	0.46
_5	Reduce costs associated with the course (e.g., purchasing a textbook)	25	0.28	0.46
_6	Interact more with me around course content	15	0.27	0.46
_7	Interact more with other students around course content	25	0.24	0.44
_8	Other (please explain)	3	1.00	0.00
45	"How much do you agree or disagree with the following statements regarding {Product}? Using {Product} in this course helped me..." (1=Strongly Agree or Agree)			
_1	Present content more effectively	26	0.31	0.47
_2	Personalize learning in response to different students' needs	25	0.52	0.51
_3	Reduce time spent assessing student learning	26	0.12	0.33
_4	Reduce the time spent on mechanical teaching tasks such as recording grades	26	0.08	0.27
_5	Reduce time spent in class	26	0.04	0.20
_6	Better monitor individual student progress	26	0.50	0.51
_7	Keep better track of whole-class progress	26	0.31	0.47
_8	Increase student engagement with the content of my course	26	0.73	0.45
_9	Use class time for more interactive activities	26	0.15	0.37
_10	Reduce time spent preparing the course at the start of the term	15	0.13	0.35
_11	Support my students in deeper learning	26	0.58	0.50
_12	Other	2	1.00	0.00
46	"Did you experience any usability and technical problems when using {Product} in your course this term (spring 2017)?" (1=Yes)	26	0.69	0.47
47	"Which of these usability and technical problems did you experience when using {Product} in your course this term?" (1=Yes)			
_1	Problems with logging or signing in (either you or your students)	18	0.67	0.49
_2	Incompatibilities with existing computer hardware or software (e.g., browser incompatibilities)	18	0.17	0.38
_3	Incompatibilities with our campus systems, such as the Learning Management or Student Information System	18	0.11	0.32
_4	Incompatibilities with other online resources	18	0.06	0.24
_5	Lack of technical or help desk support needed from my campus	18	0.17	0.38
_6	Lack of technical or help desk support needed from {Grantee}	18	0.22	0.43
_7	Confusing design of dashboard or system interface	18	0.67	0.49
_8	Other	18	0.39	0.50

Table B-3. Cerego, Product (*n*=26, 78% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
48	"Which, if any, of these problems did you experience when using {Product} in your course this term (spring 2017)?" (1=Yes)			
_1	Lack of alignment with course goals	23	0.39	0.50
_2	Time required to learn new online system	23	0.48	0.51
_3	Student resistance to using system	23	0.48	0.51
_4	Students did not use {Product} the way it was intended (i.e., attempting to succeed by exploiting properties of the system rather than learning the material)	23	0.26	0.45
_5	Did not work well within course schedule or allotted class time	23	0.13	0.34
_6	Other, please explain	17	0.12	0.33
_7	None of these	17	0.00	0.00
49	"Overall, how satisfied have you been when using {Product} in your course this term (spring 2017)?" (1=Highly or Moderately Satisfied)	26	0.69	0.47
51	"Do you plan to use {Product} in your course again?"			
	Yes, in much the same way I used it this term	7	0.27	0.45
	Yes, but in a more limited way	5	0.19	0.40
	Yes, and to a greater extent than I used it this term	3	0.12	0.33
	No	8	0.31	0.47
	Not sure	3	0.12	0.33
52	"How likely are you to recommend {Product} to a friend or colleague teaching the same course you do?" (0 to 10)	25	5.60	2.55

Table B-4. CogBooks, Product (*n*=20, 80% response rate)

Q#	Question Text	n	Mean	SD
1	Are you currently using PRODUCT in any of your courses?	8	1.00	0.00
3a	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	10	0.67	0.49
	36-99	3	0.2	0.41
	100-249	1	0.07	0.26
	250-499	1	0.07	0.26
	500 or more	0	0.00	0.00
3b	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	2	0.67	0.58
	36-99	1	0.33	0.58
	100-249	0	0.00	0.00
	250-499	0	0.00	0.00
	500 or more	0	0.00	0.00

Table B-4. CogBooks, Product (*n*=20, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
3c	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3d	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3e	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3f	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3g	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3h	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-4. CogBooks, Product (*n*=20, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
3i	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3j	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
4	Is this your first time using PRODUCT in COURSE?			
	Is this your first time using PRODUCT in COURSE?	13	0.62	0.51
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
5	Have you taught this course before without using {Product}? (1=Yes)	11	1.00	0.00
5a	Did you use another courseware product previously? (1=Yes)	0	0.00	0.00
8	Did you teach this course with PRODUCT in a previous term?	8	0.50	0.53
9	For how many terms have you used PRODUCT in the past?			
	1 term	2	0.50	0.58
	2 terms	1	0.25	0.50
	3 terms	1	0.25	0.50
	4 terms	0	0.00	0.00
	5+ terms	0	0.00	0.00
10	Have you ever taught courses with online or blended learning components before using PRODUCT?	13	0.62	0.51
11	"Last Fall, were you teaching…" (1=Yes, Full time)	11	.82	0.40
12	"Last Fall, was your position…"			
_1	Tenure track faculty	4	0.36	0.50
_2	Lecturer or Instructor	6	0.55	0.52
_3	Adjunct professor, lecturer, or instructor	1	0.09	0.30
13	"Did you have a choice to use {Product} for your course this term (spring 2017)?" (1=Yes)	8	0.50	0.53

Table B-4. CogBooks, Product (*n*=20, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
14	"What motivated you to choose {Product}?" (1=Yes)			
_1	Interest in exploring online teaching and learning	4	0.75	0.50
_2	Thought {Product} would help with course management or organization	4	0.75	0.50
_3	Thought teaching with {Product} would take less of my time	4	0.50	0.58
_4	Desire for a more flexible teaching schedule	4	0.25	0.50
_5	Opportunity for professional development	4	0.50	0.58
_6	Received an attractive incentive	4	0.00	0.00
_7	This was the only online learning tool available to me for this course	4	0.00	0.00
_8	To be consistent with other courses/sections	4	0.25	0.50
_9	Desire for a more convenient way to communicate with students	4	0.25	0.50
_10	Expectation that my students would be more engaged	4	1.00	0.00
_11	Expectation that my students would receive more individualized learning	4	1.00	0.00
_12	Encouragement from upper levels of your institution (for example, your department or college) to use {Product}	4	0.00	0.00
_13	Wanted to same my students the cost of a textbook	2	0.50	0.71
_14	Other (please explain)	4	0.00	
15	"To what extent did using {Product} change the way you…" (1=Some Change or Major Change)			
_1	Planned this course	16	0.81	0.40
_2	Presented the material for this course	16	0.94	0.25
_3	Interacted with students in this course	16	0.75	0.45
_4	Evaluated students in this course	16	0.81	0.40
16	"Did you receive training or professional development this term (spring 2017) on how to use or integrate {product} into your course to improve student learning?" (1=Yes)	12	0.67	0.49
17	"How many hours of training did you receive this term?"	10	4.20	3.91
19	"How satisfied were you with the training you received this term?" (1=Moderately or Highly Satisfied)	8	1.00	0.00
20	"Was training for {Product} offered this term (spring 2017)?" (1=Yes)	4	0.00	0.00
21	"Briefly indicate your reasons for not participating in the training for {Product} this year." (1=Yes)			
_1	Training did not align with my schedule	0		
_2	Training offered in inconvenient location or format	0		
_3	Training took too much time	0		
_4	Training occurred before I was hired	0		
_5	I took the training previously	0		
_6	Did not feel the need for training	5	0.00	
_7	Other, please describe.	0		

Table B-4. CogBooks, Product (*n*=20, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
22	"The last time you taught your course without {Product}, did you receive any training or professional development on how to design and implement instruction to improve student learning?" (1=Yes)	7	0.57	0.53
23	"How many hours of training did you receive for your course on how to design and implement instruction and to improve student learning when not using {Product}?"	4	4.50	1.73
24	"When preparing for your course this spring, how much time did you spend (in hours) learning how to use {Product}, in both formal training and individual preparation? Do not include any time spent learning the product before fall 2016.	9	8.22	5.52
25	"When preparing for your course this spring, how much time did you spend (in hours) integrating {Product} into your course (e. g., adapting assignments, adapting format of content or lesson delivery, adapting grading, etc.)? Do not include any time spent learning the product before fall 2016."	8	23.88	18.33
26	"How prepared did you feel to use {Product} this term (spring 2017)?" (1=Very or Adequately Prepared)	20	0.75	0.44
27	"Have you received support for using {Product} outside of formal training this term (spring 2017?" (1=Yes)	16	0.88	0.34
28	"From which of these sources have you received support for using {Product} this term? (1=Yes)			
_1	{Product} support staff/technical assistance	14	0.93	0.27
_2	Next Generation Courseware Challenge project leader on my campus	14	0.57	0.51
_3	Peers/colleagues also using {Product}	14	0.64	0.50
_4	Technical (IT) support staff on my campus	14	0.36	0.50
_5	Instructional design staff on my campus	14	0.50	0.52
_6	Someone else from my department	14	0.21	0.43
_7	Other (please specify)	14	0.07	0.27
29	"How helpful was this support in enabling you to use {Product} in your course this term (spring 2017)"?" (1=Very Helpful or Helpful)			
_1	{Product} support staff/technical assistance	13	0.92	0.28
_2	Next Generation Courseware Challenge project leader on my campus	8	1.00	0.00
_3	Peers/colleagues also using {Product}	9	1.00	0.00
_4	Technical (IT) support staff on my campus	4	1.00	0.00
_5	Instructional design staff on my campus	7	1.00	0.00
_6	Someone else from my department	3	1.00	0.00
_7	Other (please specify)	1	1.00	0.00
30	"Which of the following best describes how {Product} is/was used in your course this term (spring 2017)?"			
	Substitute for printed text as core course component	5	0.25	0.44
	Substitute for some lecture/class meeting time	0	0.00	0.00
	Supplemental source of course content	3	0.15	0.37
	Skills practice environment	1	0.05	0.22
	Formative assessment system	0	0.00	0.00
	Flipping the classroom (i.e., using the product to cover content in advance so that class time could be used for more active activities)	8	0.40	0.50
	Fully online delivery of course	3	0.15	0.37

Table B-4. CogBooks, Product (*n*=20, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
31	"What proportion of the content in your course is being delivered using {Product}?"			
	0% to 24%	0	0.00	0.00
	25% to 49%	3	0.20	0.41
	50% to 79%	6	0.40	0.51
	80% to 100%	6	0.40	0.51
32	"Before the start of your course this term (spring 2017), how many hours would you estimate you spent planning your instruction and student assignments?"	4	25.00	12.91
33a	"Think about a typical week teaching your course this term (spring 2017). How many hours did you spend on each of the following course-related activities during that week?"			
	Presenting course content and leading course instruction hours	4	4.25	1.26
	Interacting with students (including office hours, email correspondence, etc.)	4	4.50	0.58
	Evaluating or providing written feedback on student work	4	3.75	0.50
	Course administration (e.g. entering grades, technology assistance, etc.)	4	6.25	4.03
	Revising your plan for instruction and student assignments	4	5.00	1.41
34	"How many hours did you spend planning instruction and student assignments before the course started for {Course} with and without using {Product}?"			
1_1	With {Product}	10	15.00	12.62
2_1	Without using {Product}	10	20.10	15.84
35	"During a typical week, how many hours did/do you spend performing the following tasks for {Course} with and without using {Product}?"			
1_1	With using {Product}: Presenting course content and leading course instruction hours	11	5.18	4.42
1_2	With using {Product}: Interacting with students (including office hours, email correspondence, etc.)	11	4.73	2.61
1_3	With using {Product}: Evaluating or providing written feedback on student work	11	5.09	2.95
1_4	With using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	11	3.36	1.36
1_5	With using {Product}: Revising your plan for instruction and student assignments	11	3.64	2.16
2_1	Without using {Product}: Presenting course content and leading course instruction hours	11	6.18	4.35
2_2	Without using {Product}: Interacting with students (including office hours, email correspondence, etc.)	11	5.27	5.00
2_3	Without using {Product}: Evaluating or providing written feedback on student work	11	6.45	5.50
2_4	Without using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	11	4.91	4.89
2_5	Without using {Product}: Revising your plan for instruction and student assignments	11	5.64	4.01
36	"Overall, how would you describe the impact of using {Product} on the time you spend on your course?" (1= Major or Minor Time Saver)	15	0.47	0.52
37	How important is the ability to print content to use PRODUCT?	8	0.63	0.52

Table B-4. CogBooks, Product (*n*=20, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
38	Who pays for printing?			
	College pays for printing	1	0.20	0.45
	Students pays for printing	4	0.80	0.45
	Other pays for printing	0	0.00	0.00
39	Approximately how many pages per student are printed over the entire course?			
	0-50 pages	2	0.67	0.58
	51-100 pages	0	0.00	0.00
	101-150 pages	1	0.33	0.58
	151-200 pages	0	0.00	0.00
	200+ pages	0	0.00	0.00
40	"When your course is taught at your institution without {Product}, are textbooks or other materials generally required or recommended for students?" (1=Yes)	15	1.00	0.00
41	"What is the approximate cost of text and other materials for your course when teaching it without {Product}?" (1=Less than $25, 7=More than $275)			
	Less than $25	0	0.00	0.00
	$26-$75	2	0.13	0.35
	$76-$125	6	0.40	0.51
	$126-$175	3	0.20	0.41
	$176-$225	3	0.20	0.41
	$226-$275	0	0.00	0.00
	More than $275	1	0.07	0.26
	Don't know	0	0.00	0.00
42	"Is your course staffed differently when using {Product}?"			
_1	Yes, more staff	7	0.47	0.52
_2	Yes, less staff	1	0.07	0.26
_3	No, same staff	7	0.47	0.52
_4	Don't Know	0	0.00	0.00
43	"How frequently do you use each of the following instructor-oriented features of {Product}?" (1=Used All or Some of the Time)			
_1	Used online gradebook to keep track of individual students' performance	18	0.67	0.49
_2	Used dashboards to track progress of the class as a whole	20	0.75	0.44
_3	Used dashboard to check individual students' progress in understanding concepts and content	20	0.70	0.47
_4	Used dashboard to check when individual students last logged in to {Product}	20	0.50	0.51
_5	Used {Product} student performance data to refer individual students to specific content or problem activities	19	0.53	0.51
_6	Adjusted the structure or sequencing of course content in {Product} for some students	19	0.42	0.51
_7	Used {Product} to communicate with students	20	0.35	0.49
_8	Used {Product} to make class materials available to students	17	0.65	0.49
_9	Identifying common misconceptions so that I could address them during class time	20	0.80	0.41

Table B-4. CogBooks, Product (*n*=20, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
44	"How much do you agree or disagree with the following statements? Using {Product} helps students…" (1=Strongly Agree or Agree)			
_1	Better understand and remember course content	20	0.75	0.44
_2	Better analyze and apply course content	20	0.75	0.44
_3	Complete more complex assignments that demonstrate their understanding of course content	18	0.56	0.51
_4	Stay more engaged in the course	20	0.85	0.37
_5	Reduce costs associated with the course (e.g., purchasing a textbook)	18	0.67	0.49
_6	Interact more with me around course content	15	0.93	0.26
_7	Interact more with other students around course content	20	0.60	0.50
_8	Other (please explain)	2	0.50	0.71
45	"How much do you agree or disagree with the following statements regarding {Product}? Using {Product} in this course helped me..." (1=Strongly Agree or Agree)			
_1	Present content more effectively	20	0.75	0.44
_2	Personalize learning in response to different students' needs	19	0.84	0.37
_3	Reduce time spent assessing student learning	20	0.55	0.51
_4	Reduce the time spent on mechanical teaching tasks such as recording grades	19	0.21	0.42
_5	Reduce time spent in class	19	0.32	0.48
_6	Better monitor individual student progress	20	0.65	0.49
_7	Keep better track of whole-class progress	20	0.80	0.41
_8	Increase student engagement with the content of my course	20	0.80	0.41
_9	Use class time for more interactive activities	20	0.60	0.50
_10	Reduce time spent preparing the course at the start of the term	15	0.47	0.52
_11	Support my students in deeper learning	20	0.60	0.50
_12	Other	1	1.00	0.00
46	"Did you experience any usability and technical problems when using {Product} in your course this term (spring 2017)?" (1=Yes)	16	0.81	0.40
47	"Which of these usability and technical problems did you experience when using {Product} in your course this term?" (1=Yes)			
_1	Problems with logging or signing in (either you or your students)	13	0.77	0.44
_2	Incompatibilities with existing computer hardware or software (e.g., browser incompatibilities)	13	0.77	0.44
_3	Incompatibilities with our campus systems, such as the Learning Management or Student Information System	13	0.08	0.28
_4	Incompatibilities with other online resources	13	0.15	0.38
_5	Lack of technical or help desk support needed from my campus	13	0.00	0.00
_6	Lack of technical or help desk support needed from {Grantee}	13	0.23	0.44
_7	Confusing design of dashboard or system interface	13	0.38	0.51
_8	Other	12	0.08	0.29

Table B-4. CogBooks, Product (*n*=20, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
48	"Which, if any, of these problems did you experience when using {Product} in your course this term (spring 2017)?" (1=Yes)			
_1	Lack of alignment with course goals	20	0.25	0.44
_2	Time required to learn new online system	20	0.15	0.37
_3	Student resistance to using system	20	0.15	0.37
_4	Students did not use {Product} the way it was intended (i.e., attempting to succeed by exploiting properties of the system rather than learning the material)	20	0.40	0.50
_5	Did not work well within course schedule or allotted class time	20	0.10	0.31
_6	Other, please explain	14	0.00	0.00
_7	None of these	14	0.21	0.43
49	"Overall, how satisfied have you been when using {Product} in your course this term (spring 2017)?" (1=Highly or Moderately Satisfied)	20	1.15	0.93
51	"Do you plan to use {Product} in your course again?"			
	Yes, in much the same way I used it this term	11	0.55	0.51
	Yes, but in a more limited way	5	0.25	0.44
	Yes, and to a greater extent than I used it this term	4	0.20	0.41
	No	0		
	Not sure	0		
52	"How likely are you to recommend {Product} to a friend or colleague teaching the same course you do?" (0 to 10)	20	7.65	2.23

Table B-5. Lumen, Product (n=108, 70% response rate)

Q#	Question Text	n	Mean	SD
1	Are you currently using PRODUCT in any of your courses?	48	1.00	0.00
3a	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	54	0.92	0.28
	36-99	5	0.08	0..28
	100-249	0		
	250-499	0		
	500 or more	0		
3b	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	14	0.88	0.34
	36-99	2	0.13	0.34
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-5. Lumen, Product (n=108, 70% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
3c	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	4	0.67	0.52
	36-99	2	0.33	0.52
	100-249	0		
	250-499	0		
	500 or more	0		
3d	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	3	0.75	0.50
	36-99	1	0.25	0.50
	100-249	0		
	250-499	0		
	500 or more	0		
3e	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	3	0.75	0.50
	36-99	1	0.25	0.50
	100-249	0		
	250-499	0		
	500 or more	0		
3f	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	0.50	0.71
	36-99	1	0.50	0.71
	100-249	0		
	250-499	0		
	500 or more	0		
3g	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3h	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-5. Lumen, Product (n=108, 70% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
3i	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3j	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
4	Is this your first time using PRODUCT in COURSE?			
	Is this your first time using PRODUCT in COURSE?	97	0.48	0.50
	Is this your first time using PRODUCT in COURSE?	15	0.60	0.51
	Is this your first time using PRODUCT in COURSE?	3	0.67	0.58
	Is this your first time using PRODUCT in COURSE?	1	1.00	0.00
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
5	Have you taught this course before without using {Product}? (1=Yes)	15	1.00	0.00
5a	Did you use another courseware product previously? (1=Yes)	0		
8	Did you teach this course with PRODUCT in a previous term?	48	0.73	0.45
9	For how many terms have you used PRODUCT in the past?			
	1 term	6	0.17	0.38
	2 terms	11	0.31	0.47
	3 terms	10	0.29	0.46
	4 terms	4	0.11	0.32
	5+ terms	4	0.11	0.32
10	Have you ever taught courses with online or blended learning components before using PRODUCT?	97	0.74	0.44
11	"Last Fall, were you teaching…" (1=Yes, Full time)	49	.49	0.51
12	"Last Fall, was your position…"			
_1	Tenure track faculty	23	0.47	0.50
_2	Lecturer or Instructor	3	0.06	0.24
_3	Adjunct professor, lecturer, or instructor	23	0.47	0.50
13	"Did you have a choice to use {Product} for your course this term (spring 2017)?" (1=Yes)	85	0.36	0.48

Table B-5. Lumen, Product (n=108, 70% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
14	"What motivated you to choose {Product}?" (1=Yes)			
_1	Interest in exploring online teaching and learning	31	0.77	0.43
_2	Thought {Product} would help with course management or organization	31	0.81	0.40
_3	Thought teaching with {Product} would take less of my time	31	0.35	0.49
_4	Desire for a more flexible teaching schedule	31	0.26	0.44
_5	Opportunity for professional development	31	0.77	0.43
_6	Received an attractive incentive	31	0.23	0.43
_7	This was the only online learning tool available to me for this course	31	0.06	0.25
_8	To be consistent with other courses/sections	31	0.26	0.44
_9	Desire for a more convenient way to communicate with students	31	0.55	0.51
_10	Expectation that my students would be more engaged	31	0.84	0.37
_11	Expectation that my students would receive more individualized learning	31	0.90	0.30
_12	Encouragement from upper levels of your institution (for example, your department or college) to use {Product}	31	0.39	0.50
_13	Wanted to same my students the cost of a textbook	1	1.00	0.00
_14	Other (please explain)	31	0.23	0.43
15	"To what extent did using {Product} change the way you…" (1=Some Change or Major Change)			
_1	Planned this course	98	0.59	0.49
_2	Presented the material for this course	98	0.74	0.44
_3	Interacted with students in this course	98	0.76	0.43
_4	Evaluated students in this course	98	0.82	0.39
16	"Did you receive training or professional development this term (spring 2017) on how to use or integrate {product} into your course to improve student learning?" (1=Yes)	95	0.71	0.46
17	"How many hours of training did you receive this term?"	13	6.69	7.49
19	"How satisfied were you with the training you received this term?" (1=Moderately or Highly Satisfied)	67	0.84	0.37
20	"Was training for {Product} offered this term (spring 2017)?" (1=Yes)	27	0.52	0.51
21	"Briefly indicate your reasons for not participating in the training for {Product} this year." (1=Yes)			
_1	Training did not align with my schedule	13	0.38	0.51
_2	Training offered in inconvenient location or format	13	0.15	0.38
_3	Training took too much time	13	0.15	0.38
_4	Training occurred before I was hired	13	0.15	0.38
_5	I took the training previously	13	0.67	0.49
_6	Did not feel the need for training	62	0.13	0.34
_7	Other, please describe.	13	0.08	0.28
22	"The last time you taught your course without {Product}, did you receive any training or professional development on how to design and implement instruction to improve student learning?" (1=Yes)	4	0.00	0.00

Table B-5. Lumen, Product (n=108, 70% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
23	"How many hours of training did you receive for your course on how to design and implement instruction and to improve student learning when not using {Product}?"	0		
24	"When preparing for your course this spring, how much time did you spend (in hours) learning how to use {Product}, in both formal training and individual preparation? Do not include any time spent learning the product before fall 2016.	93	11.70	10.26
25	"When preparing for your course this spring, how much time did you spend (in hours) integrating {Product} into your course (e. g., adapting assignments, adapting format of content or lesson delivery, adapting grading, etc.)? Do not include any time spent learning the product before fall 2016."	90	13.99	13.25
26	"How prepared did you feel to use {Product} this term (spring 2017)?" (1=Very or Adequately Prepared)	108	0.78	0.42
27	"Have you received support for using {Product} outside of formal training this term (spring 2017?" (1=Yes)	97	0.62	0.49
28	"From which of these sources have you received support for using {Product} this term? (1=Yes)			
_1	{Product} support staff/technical assistance	60	0.83	0.38
_2	Next Generation Courseware Challenge project leader on my campus	60	0.27	0.45
_3	Peers/colleagues also using {Product}	60	0.47	0.50
_4	Technical (IT) support staff on my campus	60	0.37	0.49
_5	Instructional design staff on my campus	60	0.33	0.48
_6	Someone else from my department	60	0.28	0.45
_7	Other (please specify)	60	0.12	0.32
29	"How helpful was this support in enabling you to use {Product} in your course this term (spring 2017)"?" (1=Very Helpful or Helpful)			
_1	{Product} support staff/technical assistance	50	0.98	0.14
_2	Next Generation Courseware Challenge project leader on my campus	16	0.94	0.25
_3	Peers/colleagues also using {Product}	28	0.89	0.31
_4	Technical (IT) support staff on my campus	22	0.82	0.39
_5	Instructional design staff on my campus	20	1.00	0.00
_6	Someone else from my department	16	0.94	0.25
_7	Other (please specify)	2	1.00	0.00
30	"Which of the following best describes how {Product} is/was used in your course this term (spring 2017)?"			
	Substitute for printed text as core course component	107	0.35	0.48
	Substitute for some lecture/class meeting time	107	0.02	0.14
	Supplemental source of course content	107	0.07	0.25
	Skills practice environment	107	0.03	0.17
	Formative assessment system	107	0.06	0.23
	Flipping the classroom (i.e., using the product to cover content in advance so that class time could be used for more active activities)	107	0.01	0.10
	Fully online delivery of course	107	0.48	0.50

Table B-5. Lumen, Product (n=108, 70% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
31	"What proportion of the content in your course is being delivered using {Product}?"			
	0% to 24%	5	0.08	0.28
	25% to 49%	1	0.02	0.13
	50% to 79%	17	0.29	0.46
	80% to 100%	36	0.61	0.49
32	"Before the start of your course this term (spring 2017), how many hours would you estimate you spent planning your instruction and student assignments?"	10	9.60	7.78
33a	"Think about a typical week teaching your course this term (spring 2017). How many hours did you spend on each of the following course-related activities during that week?"			
	Presenting course content and leading course instruction hours	10	6.30	4.99
	Interacting with students (including office hours, email correspondence, etc.)	10	7.60	6.70
	Evaluating or providing written feedback on student work	10	4.30	1.83
	Course administration (e.g. entering grades, technology assistance, etc.)	10	4.10	2.42
	Revising your plan for instruction and student assignments	10	5.00	1.41
34	"How many hours did you spend planning instruction and student assignments before the course started for {Course} with and without using {Product}?"			
1_1	With {Product}	15	10.60	6.85
2_1	Without using {Product}	15	15.00	11.88
35	"During a typical week, how many hours did/do you spend performing the following tasks for {Course} with and without using {Product}?"			
1_1	With using {Product}: Presenting course content and leading course instruction hours	15	5.00	2.98
1_2	With using {Product}: Interacting with students (including office hours, email correspondence, etc.)	15	4.73	2.09
1_3	With using {Product}: Evaluating or providing written feedback on student work	15	5.00	3.51
1_4	With using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	15	3.07	2.34
1_5	With using {Product}: Revising your plan for instruction and student assignments	15	3.73	3.13
2_1	Without using {Product}: Presenting course content and leading course instruction hours	15	5.67	2.94
2_2	Without using {Product}: Interacting with students (including office hours, email correspondence, etc.)	15	4.87	2.29
2_3	Without using {Product}: Evaluating or providing written feedback on student work	15	5.73	5.23
2_4	Without using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	15	3.13	2.26
2_5	Without using {Product}: Revising your plan for instruction and student assignments	15	4.27	5.02
36	"Overall, how would you describe the impact of using {Product} on the time you spend on your course?" (1= Major or Minor Time Saver)	24	0.58	0.50
37	How important is the ability to print content to use PRODUCT?	13	0.69	0.48

Table B-5. Lumen, Product (n=108, 70% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
38	Who pays for printing?			
	College pays for printing	3	0.33	0.50
	Students pays for printing	5	0.56	0.53
	Other pays for printing	1	0.11	0.33
39	Approximately how many pages per student are printed over the entire course?			
	0-50 pages	3	0.75	0.50
	51-100 pages	0		
	101-150 pages	0		
	151-200 pages	0		
	200+ pages	1	0.25	0.50
40	"When your course is taught at your institution without {Product}, are textbooks or other materials generally required or recommended for students?" (1=Yes)	24	0.83	0.38
41	"What is the approximate cost of text and other materials for your course when teaching it without {Product}?" (1=Less than $25, 7=More than $275)			
	Less than $25	4	0.20	0.41
	$26-$75	2	0.10	0.31
	$76-$125	6	0.30	0.47
	$126-$175	2	0.10	0.31
	$176-$225	5	0.25	0.44
	$226-$275	1	0.05	0.22
	More than $275	0		
	Don't know	0		
42	"Is your course staffed differently when using {Product}?"			
_1	Yes, more staff	3	0.13	0.34
_2	Yes, less staff	1	0.04	0.20
_3	No, same staff	19	0.79	0.41
_4	Don't Know	1	0.04	0.20

Table B-5. Lumen, Product (n=108, 70% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
43	"How frequently do you use each of the following instructor-oriented features of {Product}?" (1=Used All or Some of the Time)			
_1	Used online gradebook to keep track of individual students' performance	103	0.85	0.35
_2	Used dashboards to track progress of the class as a whole	99	0.47	0.50
_3	Used dashboard to check individual students' progress in understanding concepts and content	99	0.64	0.48
_4	Used dashboard to check when individual students last logged in to {Product}	99	0.45	0.50
_5	Used {Product} student performance data to refer individual students to specific content or problem activities	100	0.61	0.49
_6	Adjusted the structure or sequencing of course content in {Product} for some students	95	0.24	0.43
_7	Used {Product} to communicate with students	102	0.70	0.46
_8	Used {Product} to make class materials available to students	102	0.79	0.41
_9	Identifying common misconceptions so that I could address them during class time	98	0.34	0.48
44	"How much do you agree or disagree with the following statements? Using {Product} helps students…" (1=Strongly Agree or Agree)			
_1	Better understand and remember course content	107	0.54	0.50
_2	Better analyze and apply course content	107	0.54	0.50
_3	Complete more complex assignments that demonstrate their understanding of course content	106	0.43	0.50
_4	Stay more engaged in the course	107	0.52	0.50
_5	Reduce costs associated with the course (e.g., purchasing a textbook)	107	0.49	0.50
_6	Interact more with me around course content	58	0.86	0.35
_7	Interact more with other students around course content	107	0.32	0.47
_8	Other (please explain)	10	0.50	0.53
45	"How much do you agree or disagree with the following statements regarding {Product}? Using {Product} in this course helped me…" (1=Strongly Agree or Agree)			
_1	Present content more effectively	107	0.61	0.49
_2	Personalize learning in response to different students' needs	106	0.58	0.50
_3	Reduce time spent assessing student learning	107	0.64	0.48
_4	Reduce the time spent on mechanical teaching tasks such as recording grades	107	0.63	0.49
_5	Reduce time spent in class	106	0.32	0.47
_6	Better monitor individual student progress	107	0.69	0.46
_7	Keep better track of whole-class progress	107	0.57	0.50
_8	Increase student engagement with the content of my course	107	0.46	0.50
_9	Use class time for more interactive activities	106	0.36	0.48
_10	Reduce time spent preparing the course at the start of the term	58	0.43	0.50
_11	Support my students in deeper learning	107	0.54	0.50
_12	Other	20	0.70	0.47

Table B-5. Lumen, Product (n=108, 70% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
46	"Did you experience any usability and technical problems when using {Product} in your course this term (spring 2017)?" (1=Yes)	97	0.46	0.50
47	"Which of these usability and technical problems did you experience when using {Product} in your course this term?" (1=Yes)			
_1	Problems with logging or signing in (either you or your students)	45	0.27	0.45
_2	Incompatibilities with existing computer hardware or software (e.g., browser incompatibilities)	45	0.42	0.50
_3	Incompatibilities with our campus systems, such as the Learning Management or Student Information System	45	0.31	0.47
_4	Incompatibilities with other online resources	45	0.22	0.42
_5	Lack of technical or help desk support needed from my campus	45	0.20	0.40
_6	Lack of technical or help desk support needed from {Grantee}	45	0.24	0.43
_7	Confusing design of dashboard or system interface	45	0.42	0.50
_8	Other	44	0.45	0.50
48	"Which, if any, of these problems did you experience when using {Product} in your course this term (spring 2017)?" (1=Yes)			
_1	Lack of alignment with course goals	86	0.10	0.31
_2	Time required to learn new online system	86	0.30	0.46
_3	Student resistance to using system	86	0.27	0.45
_4	Students did not use {Product} the way it was intended (i.e., attempting to succeed by exploiting properties of the system rather than learning the material)	86	0.35	0.48
_5	Did not work well within course schedule or allotted class time	86	0.07	0.26
_6	Other, please explain	61	0.08	0.28
_7	None of these	57	0.11	0.31
49	"Overall, how satisfied have you been when using {Product} in your course this term (spring 2017)?" (1=Highly or Moderately Satisfied)	107	0.88	0.54
51	"Do you plan to use {Product} in your course again?"			
	Yes, in much the same way I used it this term	41	0.39	0.49
	Yes, but in a more limited way	32	0.30	0.46
	Yes, and to a greater extent than I used it this term	14	0.13	0.34
	No	10	0.10	0.29
	Not sure	8	0.08	0.27
52	"How likely are you to recommend {Product} to a friend or colleague teaching the same course you do?" (0 to 10)	106	7.05	3.05

Table B-6. Rice University, Product (*n*=164, 80% response rate)

Q#	Question Text	n	Mean	SD
1	Are you currently using PRODUCT in any of your courses?	146	1.00	0.00
3a	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	158	0.96	0.19
	36-99	3	0.02	0.13
	100-249	2	0.01	0.11
	250-499	1	0.01	0.08
	500 or more	0		
3b	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	29	0.97	0.18
	36-99	0		
	100-249	1	0.07	0.18
	250-499	0		
	500 or more	0		
3c	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	10	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3d	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	3	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3e	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	2	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-6. Rice University, Product (*n*=164, 80% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
3f	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	2	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3g	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3h	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3i	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3j	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-6. Rice University, Product (*n*=164, 80% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
4	Is this your first time using PRODUCT in COURSE?			
	Is this your first time using PRODUCT in COURSE?	145	0.58	0.50
	Is this your first time using PRODUCT in COURSE?	16	0.50	0.52
	Is this your first time using PRODUCT in COURSE?	5	0.60	0.55
	Is this your first time using PRODUCT in COURSE?	1	1.00	0.00
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
5	Have you taught this course before without using {Product}? (1=Yes)	18	1.00	0.00
5a	Did you use another courseware product previously? (1=Yes)	8	0.25	0.46
8	Did you teach this course with PRODUCT in a previous term?	68	0.47	0.50
9	For how many terms have you used PRODUCT in the past?			
	1 term	35	0.51	0.50
	2 terms	20	0.29	0.46
	3 terms	9	0.13	0.34
	4 terms	2	0.03	0.17
	5+ terms	2	0.03	0.17
10	Have you ever taught courses with online or blended learning components before using PRODUCT?	145	0.67	0.47
11	"Last Fall, were you teaching…" (1=Yes, Full time)	157	.82	0.39
12	"Last Fall, was your position…"			
_1	Tenure track faculty	100	0.64	0.48
_2	Lecturer or Instructor	29	0.18	0.39
_3	Adjunct professor, lecturer, or instructor	28	0.18	0.38
13	"Did you have a choice to use {Product} for your course this term (spring 2017)?" (1=Yes)	157	0.96	0.19

Table B-6. Rice University, Product (*n*=164, 80% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
14	"What motivated you to choose {Product}?" (1=Yes)			
_1	Interest in exploring online teaching and learning	151	0.70	0.46
_2	Thought {Product} would help with course management or organization	151	0.44	0.50
_3	Thought teaching with {Product} would take less of my time	151	0.25	0.43
_4	Desire for a more flexible teaching schedule	151	0.07	0.26
_5	Opportunity for professional development	151	0.23	0.42
_6	Received an attractive incentive	151	0.05	0.21
_7	This was the only online learning tool available to me for this course	151	0.11	0.32
_8	To be consistent with other courses/sections	151	0.09	0.29
_9	Desire for a more convenient way to communicate with students	151	0.25	0.44
_10	Expectation that my students would be more engaged	151	0.86	0.35
_11	Expectation that my students would receive more individualized learning	151	0.83	0.38
_12	Encouragement from upper levels of your institution (for example, your department or college) to use {Product}	151	0.09	0.28
_13	Wanted to same my students the cost of a textbook	10	0.80	0.42
_14	Other (please explain)	151	0.34	0.47
15	"To what extent did using {Product} change the way you…" (1=Some Change or Major Change)			
_1	Planned this course	157	0.24	0.43
_2	Presented the material for this course	157	0.20	0.40
_3	Interacted with students in this course	157	0.19	0.39
_4	Evaluated students in this course	157	0.38	0.49
16	"Did you receive training or professional development this term (spring 2017) on how to use or integrate {product} into your course to improve student learning?" (1=Yes)	164	0.21	0.41
17	"How many hours of training did you receive this term?"	6	1.83	0.75
19	"How satisfied were you with the training you received this term?" (1=Moderately or Highly Satisfied)	34	0.91	0.29
20	"Was training for {Product} offered this term (spring 2017)?" (1=Yes)	130	0.30	0.46
21	"Briefly indicate your reasons for not participating in the training for {Product} this year." (1=Yes)			
_1	Training did not align with my schedule	39	0.26	0.44
_2	Training offered in inconvenient location or format	39	0.03	0.16
_3	Training took too much time	38	0.18	0.39
_4	Training occurred before I was hired	39	0.00	
_5	I took the training previously	38	0.29	0.46
_6	Did not feel the need for training	39	0.67	0.48
_7	Other, please describe.	38	0.08	0.27

Table B-6. Rice University, Product (*n*=164, 80% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
22	"The last time you taught your course without {Product}, did you receive any training or professional development on how to design and implement instruction to improve student learning?" (1=Yes)	11	0.18	0.40
23	"How many hours of training did you receive for your course on how to design and implement instruction and to improve student learning when not using {Product}?"	2	7.00	4.24
24	"When preparing for your course this spring, how much time did you spend (in hours) learning how to use {Product}, in both formal training and individual preparation? Do not include any time spent learning the product before fall 2016.	146	2.45	2.56
25	"When preparing for your course this spring, how much time did you spend (in hours) integrating {Product} into your course (e. g., adapting assignments, adapting format of content or lesson delivery, adapting grading, etc.)? Do not include any time spent learning the product before fall 2016."	146	15.57	16.35
26	"How prepared did you feel to use {Product} this term (spring 2017)?" (1=Very or Adequately Prepared)	164	0.66	0.48
27	"Have you received support for using {Product} outside of formal training this term (spring 2017?" (1=Yes)	157	0.31	0.46
28	"From which of these sources have you received support for using {Product} this term? (1=Yes)			
_1	{Product} support staff/technical assistance	49	0.92	0.28
_2	Next Generation Courseware Challenge project leader on my campus	49	0.10	0.31
_3	Peers/colleagues also using {Product}	49	0.16	0.37
_4	Technical (IT) support staff on my campus	49	0.02	0.14
_5	Instructional design staff on my campus	49	0.06	0.24
_6	Someone else from my department	49	0.04	0.20
_7	Other (please specify)	49	0.06	0.24
29	"How helpful was this support in enabling you to use {Product} in your course this term (spring 2017)"?" (1=Very Helpful or Helpful)			
_1	{Product} support staff/technical assistance	45	0.91	0.29
_2	Next Generation Courseware Challenge project leader on my campus	5	0.60	0.55
_3	Peers/colleagues also using {Product}	8	0.88	0.35
_4	Technical (IT) support staff on my campus	1	1.00	0.00
_5	Instructional design staff on my campus	3	0.67	0.58
_6	Someone else from my department	1	0.00	
_7	Other (please specify)	3	1.00	0.00
30	"Which of the following best describes how {Product} is/was used in your course this term (spring 2017)?"			
	Substitute for printed text as core course component	41	0.25	0.43
	Substitute for some lecture/class meeting time	1	0.01	0.08
	Supplemental source of course content	34	0.21	0.41
	Skills practice environment	58	0.35	0.48
	Formative assessment system	13	0.08	0.27
	Flipping the classroom (i.e., using the product to cover content in advance so that class time could be used for more active activities)	14	0.09	0.28
	Fully online delivery of course	3	0.02	0.13

Table B-6. Rice University, Product (*n*=164, 80% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
31	"What proportion of the content in your course is being delivered using {Product}?"			
	0% to 24%	100	0.61	0.49
	25% to 49%	27	0.16	0.37
	50% to 79%	13	0.08	0.27
	80% to 100%	24	0.15	0.35
32	"Before the start of your course this term (spring 2017), how many hours would you estimate you spent planning your instruction and student assignments?"	0		
33a	"Think about a typical week teaching your course this term (spring 2017). How many hours did you spend on each of the following course-related activities during that week?"			
	Presenting course content and leading course instruction hours	0		
	Interacting with students (including office hours, email correspondence, etc.)	0		
	Evaluating or providing written feedback on student work	0		
	Course administration (e.g. entering grades, technology assistance, etc.)	0		
	Revising your plan for instruction and student assignments	0		
34	"How many hours did you spend planning instruction and student assignments before the course started for {Course} with and without using {Product}?"			
1_1	With {Product}	18	11.78	8.63
2_1	Without using {Product}	18	11.28	8.64
35	"During a typical week, how many hours did/do you spend performing the following tasks for {Course} with and without using {Product}?"			
1_1	With using {Product}: Presenting course content and leading course instruction hours	18	6.83	8.51
1_2	With using {Product}: Interacting with students (including office hours, email correspondence, etc.)	18	5.61	3.38
1_3	With using {Product}: Evaluating or providing written feedback on student work	18	4.06	3.24
1_4	With using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	18	4.33	3.79
1_5	With using {Product}: Revising your plan for instruction and student assignments	18	3.11	2.42
2_1	Without using {Product}: Presenting course content and leading course instruction hours	18	6.83	8.51
2_2	Without using {Product}: Interacting with students (including office hours, email correspondence, etc.)	18	5.33	3.51
2_3	Without using {Product}: Evaluating or providing written feedback on student work	18	4.11	3.25
2_4	Without using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	18	4.06	3.35
2_5	Without using {Product}: Revising your plan for instruction and student assignments	18	2.67	1.71
36	"Overall, how would you describe the impact of using {Product} on the time you spend on your course?" (1= Major or Minor Time Saver)	18	0.11	0.32
37	How important is the ability to print content to use PRODUCT?	0		

Table B-6. Rice University, Product (*n*=164, 80% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
38	Who pays for printing?			
	College pays for printing	0		
	Students pays for printing	0		
	Other pays for printing	0		
39	Approximately how many pages per student are printed over the entire course?			
	0-50 pages	0		
	51-100 pages	0		
	101-150 pages	0		
	151-200 pages	0		
	200+ pages	0		
40	"When your course is taught at your institution without {Product}, are textbooks or other materials generally required or recommended for students?" (1=Yes)	18	.89	.32
41	"What is the approximate cost of text and other materials for your course when teaching it without {Product}?" (1=Less than $25, 7=More than $275)			
	Less than $25	7	0.44	0.51
	$26-$75	1	0.06	0.25
	$76-$125	4	0.25	0.45
	$126-$175	0	0.00	0.00
	$176-$225	2	0.13	0.34
	$226-$275	0	0.00	0.00
	More than $275	2	0.13	0.34
	Don't know	0	0.00	0.00
42	"Is your course staffed differently when using {Product}?"			
_1	Yes, more staff	2	0.11	0.32
_2	Yes, less staff	0	0.00	0.00
_3	No, same staff	15	0.83	0.38
_4	Don't Know	1	0.06	0.24

Table B-6. Rice University, Product (*n*=164, 80% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
43	"How frequently do you use each of the following instructor-oriented features of {Product}?" (1=Used All or Some of the Time)			
_1	Used online gradebook to keep track of individual students' performance	157	0.59	0.49
_2	Used dashboards to track progress of the class as a whole	161	0.45	0.50
_3	Used dashboard to check individual students' progress in understanding concepts and content	162	0.49	0.50
_4	Used dashboard to check when individual students last logged in to {Product}	161	0.24	0.43
_5	Used {Product} student performance data to refer individual students to specific content or problem activities	160	0.22	0.41
_6	Adjusted the structure or sequencing of course content in {Product} for some students	156	0.09	0.29
_7	Used {Product} to communicate with students	150	0.04	0.20
_8	Used {Product} to make class materials available to students	155	0.39	0.49
_9	Identifying common misconceptions so that I could address them during class time	162	0.30	0.46
44	"How much do you agree or disagree with the following statements? Using {Product} helps students…" (1=Strongly Agree or Agree)			
_1	Better understand and remember course content	164	0.72	0.45
_2	Better analyze and apply course content	164	0.59	0.49
_3	Complete more complex assignments that demonstrate their understanding of course content	164	0.40	0.49
_4	Stay more engaged in the course	164	0.73	0.45
_5	Reduce costs associated with the course (e.g., purchasing a textbook)	164	0.35	0.48
_6	Interact more with me around course content	164	0.82	0.39
_7	Interact more with other students around course content	164	0.26	0.44
_8	Other (please explain)	31	0.32	0.48
45	"How much do you agree or disagree with the following statements regarding {Product}? Using {Product} in this course helped me..." (1=Strongly Agree or Agree)			
_1	Present content more effectively	163	0.38	0.49
_2	Personalize learning in response to different students' needs	164	0.40	0.49
_3	Reduce time spent assessing student learning	164	0.27	0.45
_4	Reduce the time spent on mechanical teaching tasks such as recording grades	164	0.22	0.42
_5	Reduce time spent in class	164	0.10	0.31
_6	Better monitor individual student progress	164	0.59	0.49
_7	Keep better track of whole-class progress	164	0.55	0.50
_8	Increase student engagement with the content of my course	163	0.67	0.47
_9	Use class time for more interactive activities	164	0.42	0.50
_10	Reduce time spent preparing the course at the start of the term	163	0.14	0.35
_11	Support my students in deeper learning	164	0.65	0.48
_12	Other	38	0.47	0.51

Table B-6. Rice University, Product (*n*=164, 80% response rate) (Cont'd.)

Q#	Question Text	n	Mean	SD
46	"Did you experience any usability and technical problems when using {Product} in your course this term (spring 2017)?" (1=Yes)	156	0.45	0.50
47	"Which of these usability and technical problems did you experience when using {Product} in your course this term?" (1=Yes)			
_1	Problems with logging or signing in (either you or your students)	71	0.70	0.46
_2	Incompatibilities with existing computer hardware or software (e.g., browser incompatibilities)	71	0.25	0.44
_3	Incompatibilities with our campus systems, such as the Learning Management or Student Information System	71	0.23	0.42
_4	Incompatibilities with other online resources	71	0.06	0.23
_5	Lack of technical or help desk support needed from my campus	71	0.21	0.41
_6	Lack of technical or help desk support needed from {Grantee}	71	0.13	0.34
_7	Confusing design of dashboard or system interface	71	0.35	0.48
_8	Other	71	0.49	0.50
48	"Which, if any, of these problems did you experience when using {Product} in your course this term (spring 2017)?" (1=Yes)			
_1	Lack of alignment with course goals	163	0.16	0.37
_2	Time required to learn new online system	163	0.19	0.39
_3	Student resistance to using system	163	0.43	0.50
_4	Students did not use {Product} the way it was intended (i.e., attempting to succeed by exploiting properties of the system rather than learning the material)	163	0.44	0.50
_5	Did not work well within course schedule or allotted class time	163	0.05	0.22
_6	Other, please explain	133	0.20	0.40
_7	None of these	126	0.05	0.21
49	"Overall, how satisfied have you been when using {Product} in your course this term (spring 2017)?" (1=Highly or Moderately Satisfied)	163	0.85	0.36
51	"Do you plan to use {Product} in your course again?"			
	Yes, in much the same way I used it this term	41	0.25	0.44
	Yes, but in a more limited way	84	0.52	0.50
	Yes, and to a greater extent than I used it this term	14	0.09	0.28
	No	17	0.10	0.31
	Not sure	7	0.04	0.20
52	"How likely are you to recommend {Product} to a friend or colleague teaching the same course you do?" (0 to 10)	163	6.26	2.40

Table B-7. Smart Sparrow, Product (n=100, 80% response rate)

Q#	Question Text	n	Mean	SD
1	Are you currently using PRODUCT in any of your courses?	56	1.00	0.00
3a	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	74	0.94	0.25
	36-99	5	0.06	0.25
	100-249	0		
	250-499	0		
	500 or more	0		
3b	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	13	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3c	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	5	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3d	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	3	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3e	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	1	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-7. Smart Sparrow, Product (n=100, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
3f	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3g	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3h	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3i	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3j	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-7. Smart Sparrow, Product (n=100, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
4	Is this your first time using PRODUCT in COURSE?			
	Is this your first time using PRODUCT in COURSE?	77	0.74	0.44
	Is this your first time using PRODUCT in COURSE?	5	1.00	0.00
	Is this your first time using PRODUCT in COURSE?	1	1.00	0.00
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
5	Have you taught this course before without using {Product}? (1=Yes)	33	0.91	0.29
5a	Did you use another courseware product previously? (1=Yes)	0		
8	Did you teach this course with PRODUCT in a previous term?	156	0.23	0.43
9	For how many terms have you used PRODUCT in the past?			
	1 term	9	0.69	0.48
	2 terms	2	0.15	0.38
	3 terms	1	0.08	0.28
	4 terms	0		
	5+ terms	1	0.08	0.28
10	Have you ever taught courses with online or blended learning components before using PRODUCT?	77	0.58	0.50
11	"Last Fall, were you teaching…" (1=Yes, Full time)	67	.84	0.37
12	"Last Fall, was your position…"			
_1	Tenure track faculty	31	0.46	0.50
_2	Lecturer or Instructor	25	0.37	0.49
_3	Adjunct professor, lecturer, or instructor	11	0.16	0.37
13	"Did you have a choice to use {Product} for your course this term (spring 2017)?" (1=Yes)	73	0.79	0.41

Table B-7. Smart Sparrow, Product (n=100, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
14	"What motivated you to choose {Product}?" (1=Yes)			
_1	Interest in exploring online teaching and learning	58	0.79	0.41
_2	Thought {Product} would help with course management or organization	58	0.43	0.50
_3	Thought teaching with {Product} would take less of my time	58	0.12	0.33
_4	Desire for a more flexible teaching schedule	58	0.12	0.33
_5	Opportunity for professional development	58	0.59	0.50
_6	Received an attractive incentive	58	0.12	0.33
_7	This was the only online learning tool available to me for this course	58	0.07	0.26
_8	To be consistent with other courses/sections	58	0.10	0.31
_9	Desire for a more convenient way to communicate with students	58	0.19	0.40
_10	Expectation that my students would be more engaged	58	0.95	0.22
_11	Expectation that my students would receive more individualized learning	58	0.84	0.37
_12	Encouragement from upper levels of your institution (for example, your department or college) to use {Product}	58	0.36	0.48
_13	Wanted to same my students the cost of a textbook	5	0.80	0.45
_14	Other (please explain)	58	0.24	0.43
15	"To what extent did using {Product} change the way you…" (1=Some Change or Major Change)			
_1	Planned this course	89	0.61	0.49
_2	Presented the material for this course	88	0.58	0.50
_3	Interacted with students in this course	89	0.55	0.50
_4	Evaluated students in this course	89	0.67	0.47
16	"Did you receive training or professional development this term (spring 2017) on how to use or integrate {product} into your course to improve student learning?" (1=Yes)	84	0.60	0.49
17	"How many hours of training did you receive this term?"	23	5.39	8.07
19	"How satisfied were you with the training you received this term?" (1=Moderately or Highly Satisfied)	50	0.92	0.27
20	"Was training for {Product} offered this term (spring 2017)?" (1=Yes)	33	0.48	0.51
21	"Briefly indicate your reasons for not participating in the training for {Product} this year." (1=Yes)			
_1	Training did not align with my schedule	16	0.63	0.50
_2	Training offered in inconvenient location or format	16	0.19	0.40
_3	Training took too much time	16	0.31	0.48
_4	Training occurred before I was hired	16	0.06	0.25
_5	I took the training previously	13	0.15	0.38
_6	Did not feel the need for training	34	0.18	0.39
_7	Other, please describe.	15	0.27	0.46

Table B-7. Smart Sparrow, Product (n=100, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
22	"The last time you taught your course without {Product}, did you receive any training or professional development on how to design and implement instruction to improve student learning?" (1=Yes)	20	0.50	0.51
23	"How many hours of training did you receive for your course on how to design and implement instruction and to improve student learning when not using {Product}?"	9	8.11	12.30
24	"When preparing for your course this spring, how much time did you spend (in hours) learning how to use {Product}, in both formal training and individual preparation? Do not include any time spent learning the product before fall 2016.	70	10.70	10.31
25	"When preparing for your course this spring, how much time did you spend (in hours) integrating {Product} into your course (e. g., adapting assignments, adapting format of content or lesson delivery, adapting grading, etc.)? Do not include any time spent learning the product before fall 2016."	70	17.36	14.47
26	"How prepared did you feel to use {Product} this term (spring 2017)?" (1=Very or Adequately Prepared)	100	0.53	0.50
27	"Have you received support for using {Product} outside of formal training this term (spring 2017?" (1=Yes)	86	0.81	0.39
28	"From which of these sources have you received support for using {Product} this term? (1=Yes)			
_1	{Product} support staff/technical assistance	70	0.97	0.17
_2	Next Generation Courseware Challenge project leader on my campus	70	0.17	0.38
_3	Peers/colleagues also using {Product}	70	0.57	0.50
_4	Technical (IT) support staff on my campus	70	0.19	0.39
_5	Instructional design staff on my campus	70	0.17	0.38
_6	Someone else from my department	70	0.21	0.41
_7	Other (please specify)	70	0.07	0.26
29	"How helpful was this support in enabling you to use {Product} in your course this term (spring 2017)"?" (1=Very Helpful or Helpful)			
_1	{Product} support staff/technical assistance	68	0.85	0.36
_2	Next Generation Courseware Challenge project leader on my campus	12	0.92	0.29
_3	Peers/colleagues also using {Product}	40	0.85	0.36
_4	Technical (IT) support staff on my campus	13	0.77	0.44
_5	Instructional design staff on my campus	12	1.00	0.00
_6	Someone else from my department	15	0.67	0.49
_7	Other (please specify)	3	0.33	0.58
30	"Which of the following best describes how {Product} is/was used in your course this term (spring 2017)?"			
	Substitute for printed text as core course component	20	0.20	0.40
	Substitute for some lecture/class meeting time	7	0.07	0.26
	Supplemental source of course content	42	0.42	0.50
	Skills practice environment	7	0.07	0.26
	Formative assessment system	4	0.04	0.20
	Flipping the classroom (i.e., using the product to cover content in advance so that class time could be used for more active activities)	12	0.12	0.33
	Fully online delivery of course	8	0.08	0.27

Table B-7. Smart Sparrow, Product (n=100, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
31	"What proportion of the content in your course is being delivered using {Product}?"			
	0% to 24%	29	0.37	0.49
	25% to 49%	30	0.38	0.49
	50% to 79%	11	0.14	0.35
	80% to 100%	9	0.11	0.32
32	"Before the start of your course this term (spring 2017), how many hours would you estimate you spent planning your instruction and student assignments?"	9	12.56	6.52
33a	"Think about a typical week teaching your course this term (spring 2017). How many hours did you spend on each of the following course-related activities during that week?"			
	Presenting course content and leading course instruction hours	9	5.67	2.96
	Interacting with students (including office hours, email correspondence, etc.)	9	4.22	3.15
	Evaluating or providing written feedback on student work	9	4.44	2.01
	Course administration (e.g. entering grades, technology assistance, etc.)	9	4.56	1.51
	Revising your plan for instruction and student assignments	9	4.33	2.06
34	"How many hours did you spend planning instruction and student assignments before the course started for {Course} with and without using {Product}?"			
1_1	With {Product}	30	16.97	12.82
2_1	Without using {Product}	29	17.66	14.59
35	"During a typical week, how many hours did/do you spend performing the following tasks for {Course} with and without using {Product}?"			
1_1	With using {Product}: Presenting course content and leading course instruction hours	29	4.34	3.63
1_2	With using {Product}: Interacting with students (including office hours, email correspondence, etc.)	29	7.07	9.04
1_3	With using {Product}: Evaluating or providing written feedback on student work	30	4.00	3.77
1_4	With using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	29	3.86	3.77
1_5	With using {Product}: Revising your plan for instruction and student assignments	28	3.50	3.14
2_1	Without using {Product}: Presenting course content and leading course instruction hours	29	5.10	4.55
2_2	Without using {Product}: Interacting with students (including office hours, email correspondence, etc.)	29	6.34	6.65
2_3	Without using {Product}: Evaluating or providing written feedback on student work	29	4.83	4.97
2_4	Without using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	29	3.66	3.30
2_5	Without using {Product}: Revising your plan for instruction and student assignments	28	3.25	2.61
36	"Overall, how would you describe the impact of using {Product} on the time you spend on your course?" (1= Major or Minor Time Saver)	38	0.37	0.49

Table B-7. Smart Sparrow, Product (n=100, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
37	How important is the ability to print content to use PRODUCT?	16	0.38	0.50
38	Who pays for printing?			
	College pays for printing	2	0.33	0.52
	Students pays for printing	2	0.33	0.52
	Other pays for printing	2	0.33	0.52
39	Approximately how many pages per student are printed over the entire course?			
	0-50 pages	3	0.75	0.50
	51-100 pages	0		
	101-150 pages	1	0.25	0.50
	151-200 pages	0		
	200+ pages	0		
40	"When your course is taught at your institution without {Product}, are textbooks or other materials generally required or recommended for students?" (1=Yes)	38	1.00	0.00
41	"What is the approximate cost of text and other materials for your course when teaching it without {Product}?" (1=Less than $25, 7=More than $275)			
	Less than $25	0		
	$26-$75	5	0.14	0.35
	$76-$125	10	0.27	0.45
	$126-$175	7	0.19	0.40
	$176-$225	10	0.27	0.45
	$226-$275	4	0.11	0.31
	More than $275	0		
	Don't know	1	0.03	0.16
42	"Is your course staffed differently when using {Product}?"			
_1	Yes, more staff	3	0.08	0.28
_2	Yes, less staff	8	0.22	0.28
_3	No, same staff	23	0.64	0.49
_4	Don't Know	2	0.06	0.23

Table B-7. Smart Sparrow, Product (n=100, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
43	"How frequently do you use each of the following instructor-oriented features of {Product}?" (1=Used All or Some of the Time)			
_1	Used online gradebook to keep track of individual students' performance	97	0.62	0.49
_2	Used dashboards to track progress of the class as a whole	98	0.47	0.50
_3	Used dashboard to check individual students' progress in understanding concepts and content	96	0.40	0.49
_4	Used dashboard to check when individual students last logged in to {Product}	96	0.28	0.45
_5	Used {Product} student performance data to refer individual students to specific content or problem activities	98	0.19	0.40
_6	Adjusted the structure or sequencing of course content in {Product} for some students	98	0.21	0.41
_7	Used {Product} to communicate with students	94	0.07	0.26
_8	Used {Product} to make class materials available to students	92	0.34	0.48
_9	Identifying common misconceptions so that I could address them during class time	96	0.30	0.46
44	"How much do you agree or disagree with the following statements? Using {Product} helps students…" (1=Strongly Agree or Agree)			
_1	Better understand and remember course content	100	0.59	0.49
_2	Better analyze and apply course content	100	0.65	0.48
_3	Complete more complex assignments that demonstrate their understanding of course content	100	0.66	0.48
_4	Stay more engaged in the course	100	0.59	0.49
_5	Reduce costs associated with the course (e.g., purchasing a textbook)	99	0.38	0.49
_6	Interact more with me around course content	78	0.64	0.48
_7	Interact more with other students around course content	99	0.40	0.49
_8	Other (please explain)	9	0.56	0.53
45	"How much do you agree or disagree with the following statements regarding {Product}? Using {Product} in this course helped me…" (1=Strongly Agree or Agree)			
_1	Present content more effectively	99	0.51	0.50
_2	Personalize learning in response to different students' needs	99	0.46	0.50
_3	Reduce time spent assessing student learning	99	0.28	0.45
_4	Reduce the time spent on mechanical teaching tasks such as recording grades	99	0.24	0.43
_5	Reduce time spent in class	98	0.26	0.44
_6	Better monitor individual student progress	100	0.40	0.49
_7	Keep better track of whole-class progress	99	0.39	0.49
_8	Increase student engagement with the content of my course	100	0.68	0.47
_9	Use class time for more interactive activities	97	0.47	0.50
_10	Reduce time spent preparing the course at the start of the term	78	0.17	0.38
_11	Support my students in deeper learning	99	0.68	0.47
_12	Other	18	0.56	0.51

Table B-7. Smart Sparrow, Product (n=100, 80% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
46	"Did you experience any usability and technical problems when using {Product} in your course this term (spring 2017)?" (1=Yes)	89	0.85	0.36
47	"Which of these usability and technical problems did you experience when using {Product} in your course this term?" (1=Yes)			
_1	Problems with logging or signing in (either you or your students)	76	0.63	0.49
_2	Incompatibilities with existing computer hardware or software (e.g., browser incompatibilities)	76	0.72	0.45
_3	Incompatibilities with our campus systems, such as the Learning Management or Student Information System	76	0.36	0.48
_4	Incompatibilities with other online resources	76	0.12	0.33
_5	Lack of technical or help desk support needed from my campus	76	0.22	0.42
_6	Lack of technical or help desk support needed from {Grantee}	76	0.25	0.44
_7	Confusing design of dashboard or system interface	76	0.54	0.50
_8	Other	76	0.42	0.50
48	"Which, if any, of these problems did you experience when using {Product} in your course this term (spring 2017)?" (1=Yes)			
_1	Lack of alignment with course goals	97	0.23	0.42
_2	Time required to learn new online system	97	0.42	0.50
_3	Student resistance to using system	97	0.60	0.49
_4	Students did not use {Product} the way it was intended (i.e., attempting to succeed by exploiting properties of the system rather than learning the material)	97	0.40	0.49
_5	Did not work well within course schedule or allotted class time	97	0.16	0.37
_6	Other, please explain	86	0.22	0.42
_7	None of these	86	0.01	0.11
49	"Overall, how satisfied have you been when using {Product} in your course this term (spring 2017)?" (1=Highly or Moderately Satisfied)	100	0.92	0.82
51	"Do you plan to use {Product} in your course again?"			
	Yes, in much the same way I used it this term	28	0.28	0.45
	Yes, but in a more limited way	34	0.34	0.48
	Yes, and to a greater extent than I used it this term	12	0.12	0.33
	No	11	0.11	0.31
	Not sure	15	0.15	0.36
52	"How likely are you to recommend {Product} to a friend or colleague teaching the same course you do?" (0 to 10)	100	6.21	2.90

Table B-8. Stanford, Product (*n*=100, 79% response rate)

Q#	Question Text	n	Mean	SD
1	Are you currently using PRODUCT in any of your courses?	75	1.00	0.00
3a	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	75	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3b	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	6	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3c	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	3	1.00	0.00
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3d	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3e	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-8. Stanford, Product (*n*=100, 79% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
3f	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3g	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3h	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3i	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		
3j	"About how many students are enrolled in this section of {Course}?"			
	35 or fewer	0		
	36-99	0		
	100-249	0		
	250-499	0		
	500 or more	0		

Table B-8. Stanford, Product (*n*=100, 79% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
4	Is this your first time using PRODUCT in COURSE?			
	Is this your first time using PRODUCT in COURSE?	100	0.39	0.49
	Is this your first time using PRODUCT in COURSE?	13	0.23	0.44
	Is this your first time using PRODUCT in COURSE?	5	0.60	0.55
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
	Is this your first time using PRODUCT in COURSE?	0		
5	Have you taught this course before without using {Product}? (1=Yes)	7	0.43	0.53
5a	Did you use another courseware product previously? (1=Yes)	0	0.00	0.00
8	Did you teach this course with PRODUCT in a previous term?	75	0.57	0.50
9	For how many terms have you used PRODUCT in the past?			
	1 term	6	0.14	0.35
	2 terms	7	0.16	0.37
	3 terms	2	0.05	0.21
	4 terms	4	0.09	0.29
	5+ terms	24	0.56	0.50
10	Have you ever taught courses with online or blended learning components before using PRODUCT?	100	0.64	0.48
11	"Last Fall, were you teaching…" (1=Yes, Full time)	74	.61	0.49
12	"Last Fall, was your position…"			
_1	Tenure track faculty	39	0.53	0.50
_2	Lecturer or Instructor	8	0.11	0.31
_3	Adjunct professor, lecturer, or instructor	27	0.36	0.48
13	"Did you have a choice to use {Product} for your course this term (spring 2017)?" (1=Yes)	77	0.62	0.49

Table B-8. Stanford, Product (*n*=100, 79% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
14	"What motivated you to choose {Product}?" (1=Yes)			
_1	Interest in exploring online teaching and learning	48	0.69	0.47
_2	Thought {Product} would help with course management or organization	48	0.58	0.50
_3	Thought teaching with {Product} would take less of my time	48	0.19	0.39
_4	Desire for a more flexible teaching schedule	48	0.19	0.39
_5	Opportunity for professional development	48	0.42	0.50
_6	Received an attractive incentive	48	0.02	0.14
_7	This was the only online learning tool available to me for this course	48	0.08	0.28
_8	To be consistent with other courses/sections	48	0.40	0.49
_9	Desire for a more convenient way to communicate with students	48	0.25	0.44
_10	Expectation that my students would be more engaged	48	0.77	0.42
_11	Expectation that my students would receive more individualized learning	48	0.75	0.44
_12	Encouragement from upper levels of your institution (for example, your department or college) to use {Product}	48	0.25	0.44
_13	Wanted to same my students the cost of a textbook	0		
_14	Other (please explain)	48	0.40	0.49
15	"To what extent did using {Product} change the way you…" (1=Some Change or Major Change)			
_1	Planned this course	100	0.76	0.43
_2	Presented the material for this course	100	0.76	0.43
_3	Interacted with students in this course	100	0.63	0.49
_4	Evaluated students in this course	99	0.69	0.47
16	"Did you receive training or professional development this term (spring 2017) on how to use or integrate {product} into your course to improve student learning?" (1=Yes)	77	0.48	0.50
17	"How many hours of training did you receive this term?"	12	6.25	5.08
19	"How satisfied were you with the training you received this term?" (1=Moderately or Highly Satisfied)	37	0.97	0.16
20	"Was training for {Product} offered this term (spring 2017)?" (1=Yes)	38	0.03	0.16
21	"Briefly indicate your reasons for not participating in the training for {Product} this year." (1=Yes)			
_1	Training did not align with my schedule	1	0.00	0.00
_2	Training offered in inconvenient location or format	1	0.00	0.00
_3	Training took too much time	1	0.00	0.00
_4	Training occurred before I was hired	1	0.00	0.00
_5	I took the training previously	1	1.00	0.00
_6	Did not feel the need for training	26	0.00	0.00
_7	Other, please describe.	1	0.00	0.00

Table B-8. Stanford, Product (*n*=100, 79% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
22	"The last time you taught your course without {Product}, did you receive any training or professional development on how to design and implement instruction to improve student learning?" (1=Yes)	3	0.67	0.58
23	"How many hours of training did you receive for your course on how to design and implement instruction and to improve student learning when not using {Product}?"	2	4.00	1.41
24	"When preparing for your course this spring, how much time did you spend (in hours) learning how to use {Product}, in both formal training and individual preparation? Do not include any time spent learning the product before fall 2016.	95	11.63	11.64
25	"When preparing for your course this spring, how much time did you spend (in hours) integrating {Product} into your course (e. g., adapting assignments, adapting format of content or lesson delivery, adapting grading, etc.)? Do not include any time spent learning the product before fall 2016."	95	19.97	15.52
26	"How prepared did you feel to use {Product} this term (spring 2017)?" (1=Very or Adequately Prepared)	100	0.80	0.40
27	"Have you received support for using {Product} outside of formal training this term (spring 2017?" (1=Yes)	98	0.54	0.50
28	"From which of these sources have you received support for using {Product} this term? (1=Yes)			
_1	{Product} support staff/technical assistance	53	0.68	0.47
_2	Next Generation Courseware Challenge project leader on my campus	53	0.11	0.32
_3	Peers/colleagues also using {Product}	53	0.81	0.39
_4	Technical (IT) support staff on my campus	53	0.25	0.43
_5	Instructional design staff on my campus	53	0.23	0.42
_6	Someone else from my department	53	0.38	0.49
_7	Other (please specify)	53	0.09	0.30
29	"How helpful was this support in enabling you to use {Product} in your course this term (spring 2017)"?" (1=Very Helpful or Helpful)			
_1	{Product} support staff/technical assistance	36	0.86	0.35
_2	Next Generation Courseware Challenge project leader on my campus	6	1.00	0.00
_3	Peers/colleagues also using {Product}	43	0.86	0.35
_4	Technical (IT) support staff on my campus	12	0.50	0.52
_5	Instructional design staff on my campus	11	0.73	0.47
_6	Someone else from my department	19	0.84	0.37
_7	Other (please specify)	2	1.00	0.00
30	"Which of the following best describes how {Product} is/was used in your course this term (spring 2017)?"			
	Substitute for printed text as core course component	52	0.52	0.50
	Substitute for some lecture/class meeting time	2	0.02	0.14
	Supplemental source of course content	22	0.22	0.42
	Skills practice environment	9	0.09	0.29
	Formative assessment system	2	0.02	0.14
	Flipping the classroom (i.e., using the product to cover content in advance so that class time could be used for more active activities)	9	0.09	0.29
	Fully online delivery of course	4	0.04	0.20

Table B-8. Stanford, Product (*n*=100, 79% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
31	"What proportion of the content in your course is being delivered using {Product}?"			
	0% to 24%	15	0.20	0.40
	25% to 49%	17	0.23	0.42
	50% to 79%	23	0.31	0.46
	80% to 100%	20	0.27	0.45
32	"Before the start of your course this term (spring 2017), how many hours would you estimate you spent planning your instruction and student assignments?"	20	14.15	12.07
33a	"Think about a typical week teaching your course this term (spring 2017). How many hours did you spend on each of the following course-related activities during that week?"			
	Presenting course content and leading course instruction hours	19	6.47	2.97
	Interacting with students (including office hours, email correspondence, etc.)	19	7.74	5.69
	Evaluating or providing written feedback on student work	19	4.26	1.97
	Course administration (e.g. entering grades, technology assistance, etc.)	19	6.26	5.59
	Revising your plan for instruction and student assignments	19	6.89	5.12
34	"How many hours did you spend planning instruction and student assignments before the course started for {Course} with and without using {Product}?"			
1_1	With {Product}	3	4.67	1.53
2_1	Without using {Product}	3	6.33	4.16
35	"During a typical week, how many hours did/do you spend performing the following tasks for {Course} with and without using {Product}?"			
1_1	With using {Product}: Presenting course content and leading course instruction hours	3	6.67	3.06
1_2	With using {Product}: Interacting with students (including office hours, email correspondence, etc.)	3	3.67	2.08
1_3	With using {Product}: Evaluating or providing written feedback on student work	3	4.00	1.00
1_4	With using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	3	4.33	1.53
1_5	With using {Product}: Revising your plan for instruction and student assignments	3	3.33	0.58
2_1	Without using {Product}: Presenting course content and leading course instruction hours	3	6.67	3.06
2_2	Without using {Product}: Interacting with students (including office hours, email correspondence, etc.)	3	4.00	1.73
2_3	Without using {Product}: Evaluating or providing written feedback on student work	3	3.00	1.00
2_4	Without using {Product}: Course administration (e.g. entering grades, technology assistance, etc.)	3	3.67	1.53
2_5	Without using {Product}: Revising your plan for instruction and student assignments	3	3.33	0.58
36	"Overall, how would you describe the impact of using {Product} on the time you spend on your course?" (1= Major or Minor Time Saver)	23	0.52	0.51

Table B-8. Stanford, Product (*n*=100, 79% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
37	How important is the ability to print content to use PRODUCT?	23	0.70	0.47
38	Who pays for printing?			
	College pays for printing	9	0.56	0.51
	Students pays for printing	5	0.31	0.48
	Other pays for printing	2	0.13	0.34
39	Approximately how many pages per student are printed over the entire course?			
	0-50 pages	6	0.50	0.52
	51-100 pages	2	0.17	0.39
	101-150 pages	1	0.08	0.29
	151-200 pages	1	0.08	0.29
	200+ pages	2	0.17	0.39
40	"When your course is taught at your institution without {Product}, are textbooks or other materials generally required or recommended for students?" (1=Yes)	22	0.77	0.43
41	"What is the approximate cost of text and other materials for your course when teaching it without {Product}?" (1=Less than $25, 7=More than $275)			
	Less than $25	4	0.29	0.47
	$26-$75	0		
	$76-$125	3	0.21	0.43
	$126-$175	3	0.21	0.43
	$176-$225	4	0.29	0.47
	$226-$275	0		
	More than $275	0		
	Don't know	0		
42	"Is your course staffed differently when using {Product}?" (1=Yes, more staff)			
_1	Yes, more staff	5	0.26	0.45
_2	Yes, less staff	1	.05	.23
_3	No, same staff	13	0.68	0.48
_4	Don't Know	0		

Table B-8. Stanford, Product (*n*=100, 79% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
43	"How frequently do you use each of the following instructor-oriented features of {Product}?" (1=Used All or Some of the Time)			
_1	Used online gradebook to keep track of individual students' performance	96	0.84	0.36
_2	Used dashboards to track progress of the class as a whole	100	0.60	0.49
_3	Used dashboard to check individual students' progress in understanding concepts and content	100	0.53	0.50
_4	Used dashboard to check when individual students last logged in to {Product}	98	0.32	0.47
_5	Used {Product} student performance data to refer individual students to specific content or problem activities	99	0.30	0.46
_6	Adjusted the structure or sequencing of course content in {Product} for some students	98	0.16	0.37
_7	Used {Product} to communicate with students	99	0.19	0.40
_8	Used {Product} to make class materials available to students	97	0.41	0.49
_9	Identifying common misconceptions so that I could address them during class time	98	0.40	0.49
44	"How much do you agree or disagree with the following statements? Using {Product} helps students…" (1=Strongly Agree or Agree)			
_1	Better understand and remember course content	99	0.74	0.44
_2	Better analyze and apply course content	99	0.75	0.44
_3	Complete more complex assignments that demonstrate their understanding of course content	99	0.54	0.50
_4	Stay more engaged in the course	99	0.64	0.48
_5	Reduce costs associated with the course (e.g., purchasing a textbook)	99	0.53	0.50
_6	Interact more with me around course content	75	0.89	0.31
_7	Interact more with other students around course content	99	0.41	0.50
_8	Other (please explain)	8	0.50	0.53
45	"How much do you agree or disagree with the following statements regarding {Product}? Using {Product} in this course helped me…" (1=Strongly Agree or Agree)			
_1	Present content more effectively	99	0.69	0.47
_2	Personalize learning in response to different students' needs	99	0.47	0.50
_3	Reduce time spent assessing student learning	100	0.57	0.50
_4	Reduce the time spent on mechanical teaching tasks such as recording grades	100	0.51	0.50
_5	Reduce time spent in class	97	0.24	0.43
_6	Better monitor individual student progress	100	0.64	0.48
_7	Keep better track of whole-class progress	100	0.63	0.49
_8	Increase student engagement with the content of my course	99	0.69	0.47
_9	Use class time for more interactive activities	98	0.77	0.43
_10	Reduce time spent preparing the course at the start of the term	74	0.39	0.49
_11	Support my students in deeper learning	99	0.76	0.43
_12	Other	16	0.69	0.48

Table B-8. Stanford, Product (*n*=100, 79% response rate), (Cont'd.)

Q#	Question Text	n	Mean	SD
46	"Did you experience any usability and technical problems when using {Product} in your course this term (spring 2017)?" (1=Yes)	100	0.46	0.50
47	"Which of these usability and technical problems did you experience when using {Product} in your course this term?" (1=Yes)			
_1	Problems with logging or signing in (either you or your students)	46	0.41	0.50
_2	Incompatibilities with existing computer hardware or software (e.g., browser incompatibilities)	46	0.57	0.50
_3	Incompatibilities with our campus systems, such as the Learning Management or Student Information System	46	0.26	0.44
_4	Incompatibilities with other online resources	46	0.15	0.36
_5	Lack of technical or help desk support needed from my campus	146	0.22	0.42
_6	Lack of technical or help desk support needed from {Grantee}	46	0.11	0.31
_7	Confusing design of dashboard or system interface	46	0.37	0.49
_8	Other	43	0.42	0.50
48	"Which, if any, of these problems did you experience when using {Product} in your course this term (spring 2017)?" (1=Yes)			
_1	Lack of alignment with course goals	87	0.24	0.43
_2	Time required to learn new online system	87	0.24	0.43
_3	Student resistance to using system	87	0.46	0.50
_4	Students did not use {Product} the way it was intended (i.e., attempting to succeed by exploiting properties of the system rather than learning the material)	87	0.38	0.49
_5	Did not work well within course schedule or allotted class time	87	0.09	0.29
_6	Other, please explain	65	0.11	0.31
_7	None of these	0	0.00	0.00
49	"Overall, how satisfied have you been when using {Product} in your course this term (spring 2017)?" (1=Highly or Moderately Satisfied)	100	0.91	0.29
51	"Do you plan to use {Product} in your course again?" (1=Yes)			
	Yes, in much the same way I used it this term	22	0.22	0.42
	Yes, but in a more limited way	58	0.59	0.50
	Yes, and to a greater extent than I used it this term	9	0.09	0.29
	No	6	0.06	0.24
	Not sure	4	0.04	0.20
52	"How likely are you to recommend {Product} to a friend or colleague teaching the same course you do?" (0 to 10)	99	7.32	2.53

Appendix C: Impact Estimation Methods

The dataset screening criteria for conducting an impact analysis were: (1) submission of data for both a treatment group and a comparison group; (2) common end-of-course outcome measure (usually course grades); (3) enrollment status and common prior achievement or pretest measure (student's cumulative college GPA was an acceptable common prior achievement measure); (4) at least 30 students in each of the treatment and comparison groups; and (5) baseline equivalence (not more than .25 standard deviation difference between treatment and comparison students on any student characteristic or pretest measure).

Table C-1. Impact Analysis Variables of Interest and Their Coding Within the Impact Analyses

Variable	Coding
Student predictor variables	
Condition	1 = treatment condition
Gender	1 = female[a]
Race/Ethnicity	1 = underrepresented population[b]
Pell Status	1 = Pell-receiving or Pell-eligible[c]
Age	Continuous
First Generation College Goer	1 = Yes
Full-time Enrollment	1 = Yes
Cumulative GPA	Continuous[d]
Cumulative Credits Earned	Continuous[d]
Prior Attempts for This Course	1 = Yes
Common Pretest/Prior Achievement	Continuous[e]
Course predictor variables	
Course Duration (in weeks)	Continuous
Outcome variables	
Course grade	Continuous; 4-point grade scale
Course completion	1 = C- or better; 0 = otherwise
Credits earned in the course	Continuous
Posttest measure	Continuous

a Some institutions allowed for non-binary gender responses. These institutions and responses were rare. Such responses were coded as 0.5.
b Under Represented Population was defined as students identifying as a race/ethnicity other than Asian or White.
c The meaning of "Pell status" varied by institution. Some institutions reported Pell receiving, some reported Pell eligibility, and others reported both.
d These variables only included data prior to the term used for the impact analysis.
e Other than Cumulative GPA.

There were two main reasons for excluding predictor variables from an impact analysis. First, there was too much missingness in the data, either because the institution did not report the data (e.g., first generation college goer) or because large numbers of students lacked meaningful data (e.g., prior achievement measures such as ACT scores). Second, there was insufficient variation in the data to allow for effective statistical modeling (e.g., all courses had the same course duration).

Impact estimates for course grades were conducted using ordinary least squares regression. Multilevel modeling would have been more appropriate given the study designs (either modeling students clustered within classrooms or students clustered within instructors), however the structure of the data prevented effective multilevel modeling. Course grades were converted to a 4-point grade scale to allow for consistent interpretation of regression coefficients across impact analyses and to allow for interpretations to be meaningful in context. For example, a significant Treatment regression coefficient estimate of +0.30 could be interpreted as approximately a one-step increase in course grade (e.g., B to a B+).

Impact estimates for course completion were conducted using logistic regression. Again, multilevel logistic regression would have been more appropriate given the study designs, however the structure of the data prevented effective multilevel modeling. These predictive models were reviewed for accuracy based on correct classification rates (the ratio of students correctly predicted in either condition), sensitivity (true positive rate), and specificity (true negative rate). The desired standard for these models was for each rate to meet an 80+% threshold. These models consistently failed to meet this threshold for specificity, meaning too many non-completers were incorrectly predicted by the model to complete the course. Therefore, these models are not reported in our impact analyses.

Impact estimates for credits earned in courses and for posttest measures were not conducted due institutions not reporting these data or (in the case of credits earned) there being insufficient variation in the data for effective modeling.

SRI arrived at the decision of a minimum sample size of 30 students in each condition for conducting impact analyses based on the following assumptions:

- Assume a “large” effect size (0.35 f^2)
- Assume the standard 0.05 alpha level
- Use a non-standard 0.95 power level to more reliably detect a large effect size
- Assume three predictors (condition, enrollment status, prior achievement measure) for the minimal impact model

The resulting student-level power analysis yielded a requirement of 20 students in each condition. Given the expectation that some courseware may not, in fact, have a “large” effect size and that we expected to in practice have a greater number of predictors, this number was increased to 30 students in each condition.

It is important to note that a student-level power analysis is not in alignment with the study designs of the impact analyses. Conditions were determined at the classroom and/or teacher levels, and therefore an accurate power analysis would require clustering students within either classrooms or teachers as appropriate. Without accounting for teacher-level or classroom-level effects in the modeling (which as noted previously were not possible given the

structure of the data), there is a significant risk of impact analyses resulting in false positives (i.e., detecting false significant treatment effects) due to actual clustering effects that were not included in the statistical models. Given these risks, this power analysis should be interpreted cautiously.

SRI explored interaction effects between the treatment condition and four student-level predictors: gender, race/ethnicity, Pell status, and enrollment status. These analyses were conducted using ordinary least squares regression. Given that exploring interaction effects decreases statistical power, datasets were only analyzed for interaction effects if they contained at least 60 students in each of the treatment and control conditions. This sample size requirement was chosen out of convenience, allowing the sizable majority of datasets to be explored for interaction effects. The overwhelming majority of the interaction effects analyses contained identical predictors to the standard impact analyses to allow for meaningful comparisons across the models. For one institution the external prior achievement measure was removed from the interaction effect analysis to meet the increased sample size requirement.

Appendix D: Meta-analysis Methods

A meta-analysis was used to synthesize the results from the final 28 impact analyses. The difference in means from the impact analysis, common standard deviation of the outcome, and sample size for the treatment and control groups from each impact analysis were entered into the Comprehensive Meta-Analysis version 3 (CMA) software program. Moderator information for a given institution and course was collected through an instructor survey and from other corresponding research design documents. The meta-analyses were run assuming a random effects model and reporting Hedge's G as the effect size. The Q statistic for heterogeneity was computed to determine whether variation among the 28 impact estimates could be explained by circumstantial characteristics, such as course subject matter, class size, courseware modality, or institute type (4-year versus 2-year).

Appendix E: Cost and Cost Effectiveness Study Methods

Cost information for a given institution and course was collected through an instructor survey, on-site visits, and follow-up communications with administrators at the respective institution. All relevant data were entered into a template that captured possible cost impacts for setting up and delivering courses with the NGC courseware being evaluated and BAU, both in the initial year and on an ongoing basis. We took an "ingredients" approach[1], which identifies all inputs regardless of whether or not administrators, faculty members, or students bear the costs. The method is based on the work of Henry Levin and colleagues, who established a procedure for quantifying the opportunity costs and accounting for relevant costs (Levin 1975 & 2001).[2],[3] These categories included the costs of providing instruction (staff professional development,

1 An "ingredients" approach consists of 3 primary steps:
(1) Selecting and defining relevant cost components (a.k.a., "ingredients")
(2) Collecting information on each ingredient and applying a monetary valuation
(3) Calculating the total cost across all ingredients

2 Levin, H. (2001). Waiting for Godot: cost-effectiveness analysis in education. *New directions for evaluation, 2001*(90), 55-68.

3 Levin, H. M. (1975). Cost-effectiveness analysis in evaluation research. *Handbook of evaluation research, 2,* 89-122.

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