

Affordable Learning Georgia Textbook Transformation Grants

Final Report

Date: May 17, 2017

Grant Number: 154

Institution Name(s): Augusta University

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Course Name(s) and Course Numbers: Elementary Statistics, MATH 2210

Semester Project Began: Spring 2016 (limited implementation)

Semester(s) of Implementation: Fall 2016, Spring 2017

Average Number of Students Per Course Section: 35 (spring 2016), 27.4 (fall 2016), 30.5 (spring 2017)

Number of Course Sections Affected by Implementation: 3 (spring 2016), 13 (fall 2016), 14 (spring 2017)

Total Number of Students Affected by Implementation: 105 (spring 2016), 356 (fall 2016), 446 (spring 2017)

1. Narrative

Many members of our department were increasingly dissatisfied with the available textbooks in elementary statistics; in particular the cost of the texts which had been used in the department for the MATH 2210 course was approaching \$200 per copy and the quality of those books did not justify their cost. Therefore, a number of faculty in the department were receptive to the idea of using a low-cost textbook and this grant gave us the necessary incentive to adopt such a textbook for wide scale use in MATH 2210.

Two members of our team experimented with adopting open and low-cost materials in the MATH 2210 course prior to the award, and this grant allowed a subsequent wide-scale adoption of Illowsky and Dean's **OpenStax Introductory Statistics** (ISBN 978-1938168208). The grant allowed members of the department to develop materials to accompany the open textbook, including a set of editable lecture notes to accompany each chapter of the open text as well as notes for additional supplementary topics and a collection of problems in WebAssign that can be used to supplement the problems from the textbook.

The open textbook was piloted in a limited capacity (3 sections/105 students) in spring 2016, and in fall 2016, the open textbook became the department's default textbook in MATH 2210. Two instructors who had previously developed online sections of MATH 2210 declined to use the open textbook, as the Illowsky and Dean text can be accessed through WebAssign, but those instructors had developed online courses using the MyMathLab platform and since MyMathLab does not currently support this textbook, those instructors did not want to rebuild their online courses from scratch.

In fall 2016 and spring 2017, a total of 783 students enrolled in sections of MATH 2210 using the open textbook. Assuming an average cost difference of approximately \$100 to \$150 between the textbook previously used in the MATH 2210 course (Triola's Elementary Statistics ISBN 978-0321836960), this equates to a cost savings to the students of somewhere between \$78,000 and \$117,000 for just the 2016-17 academic year. We foresee the department continuing to use the open text for 2017-18, and so at a minimum we forecast a savings to students of \$150,000 to \$200,000 over this two year period.

We will discuss student performance and satisfaction with the open text more in section three of this report, but a Qualtrics survey indicated general student satisfaction with the open text and we did not observe any significant differences in student success rates after the adoption of the open text; however, based on the cost savings, we judge this transformation to be a success.

Perhaps the most significant result of this project was an increased awareness of the availability of open textbooks among faculty in the department. The project PI Neal Smith frequently updated the department faculty about the project and one faculty member subsequently

decided to use an open text for their Calculus courses; the project PI also decided to switch to a low-cost textbook in his Abstract Algebra course. Further, there has been discussion among the department faculty about a wide-scale adoption of an open textbook for the Calculus I/II/III sequence.

There were, however, a few things that the team would handle differently. For example, there was anecdotal evidence that neither the students nor the faculty were happy about the fact that the Illowsky/Dean textbook is integrated with WebAssign and as mentioned previously, a couple of faculty members did not want to move their online courses away from the MyMathLab platform to WebAssign. In fact, if the team had it to do again, we might have requested some support to develop online homework for the course using a truly open, no-cost-to-students platform such as the MAA's WebWorK platform (<http://webwork.maa.org/>). This would have taken the student cost per course down from \$35 for the text bundled with WebAssign down to zero.

Additionally, we administered a survey to assess student satisfaction with the open text, the online homework used in the course, and the technology used in the course, but we did not survey the students about the supplemental lecture notes which were made available to accompany the open text. We would probably opt to modify the survey to see what percentage of the students reported making use of this additional resource.

It is worth noting that through this survey, we also learned that 59% of the students participating responded that on at least one occasion they had not bought a required textbook for a course in which they had enrolled, and 38% of this student population self-reported that textbook costs directly influence the courses for which they register.

2. Quotes

The open source textbook was convenient in that I did not have to carry my textbook everywhere. The online availability was great. Technology in the course was standard and the supplemental materials are beneficial.

I thoroughly enjoy the idea of being able to open my book up in another screen on my home computer or wherever I go on my phone or tablet. It really contributes to my ability to grasp the in-betweens of what we discussed in class. I love the convenience of having it with me wherever I go.

I felt the open source text was as effective as a traditional textbook. I would definitely recommend it for the future.

3. Quantitative and Qualitative Measures

3a. Overall Measurements

Student Opinion of Materials

Was the overall student opinion about the materials used in the course positive, neutral, or negative?

Total number of students affected in this project: 888

- Positive: 41 % of 117 respondents*
- Neutral: 27 % of 117 respondents*
- Negative: 32% of 117 respondents*

*---student feedback obtained through a Qualtrics survey in which every student enrolled in a section of the course using the open textbook was invited to participate.

Student Learning Outcomes and Grades

Was the overall comparative impact on student performance in terms of learning outcomes and grades in the semester(s) of implementation over previous semesters positive, neutral, or negative?

Student outcomes should be described in detail in Section 3b.

Choose One:

- Positive: Higher performance outcomes measured over previous semester(s)
- Neutral: Same performance outcomes over previous semester(s)
- Negative: Lower performance outcomes over previous semester(s)

Student Drop/Fail/Withdraw (DFW) Rates

Was the overall comparative impact on Drop/Fail/Withdraw (DFW) rates in the semester(s) of implementation over previous semesters positive, neutral, or negative?

Drop/Fail/Withdraw Rate:

32.1% of students out of a total 446 students affected dropped/failed/withdrew from the course in the final semester of implementation.

Choose One:

- Positive: This is a lower percentage of students with D/F/W than previous semester(s)
- Neutral: This is the same percentage of students with D/F/W than previous semester(s)
- Negative: This is a higher percentage of students with D/F/W than previous semester(s)

3b. Narrative

To track any effect of the adoption of the OpenStax on student success, we chose to use a simple metric of DFW rates in the MATH 2210 course. Since these rates sometimes vary between fall and spring semester, we examined fall 2016 and spring 2017 separately. Further, since the online sections of the course offered in 2016-17 did not adopt the open textbook, we will consider those sections separately as a control group of sorts.

For a baseline, we examined all sections of MATH 2210 from fall semester 2015 and spring semester 2016, setting aside two special sections of the course with non-traditional student populations: an honors section of the course, and a section of the course specially geared for Biology majors. We also set aside the three sections of the course in which the instructor beta-tested the OpenStax textbook. Since the online sections of the course did not adopt the OpenStax textbook, we analyzed those sections separately.

In fall 2015, it was found that the DFW rate in the face to face sections of MATH 2210 was 34.2%, and in the online sections, the DFW rate was 26.8%. In spring 2016, the DFW rate in the face to face sections using the previous textbook was 36.9%, in the online sections this rate was 41.3%, and in the three sections where the OpenStax book was beta-tested, the DFW rate was 31.4%.

In fall 2016 (the first semester of wide-scale adoption of the OpenStax text), we found that in the face-to-face sections of MATH 2210 the DFW rate was 31.5%, which is a decrease from fall 2015, but this decrease in the proportion of DFW grades was not statistically significant (two-tailed p-value of approximately .42). In the online sections, the DFW rate in fall 2016 was 40%. Thus, we observed a modest uptick in success rates, and although the effect was not statistically significant, this small effect plus the student savings justified the changeover to the open text.

To control for the variable of who was teaching the course, there were three full-time faculty members who taught MATH 2210 (not online, honors, or a specialized section) in both fall 2015 and in fall 2016 and so we examined DFW rates by instructor. Our findings are below.

Instructor	DFW grades/total students in fall '15	DFW percentage	DFW grades/total students in fall '16	DFW percentage	p-value
1	39/80	48.8%	35/85	41.2%	.33
2	29/84	34.5%	17/57	29.8%	.56
3	10/31	32.2%	8/30	26.7%	.63

At the instructor level, we see similar non-statistically significant decreases in the DFW rates.

Also, our department does an assessment of the MATH 2210 once a year during the fall semester. This assessment is in the form of a multiple-part common embedded question which all faculty teaching the course are asked to put on their final exam. In both fall 2015 and fall 2016, the embedded question covered similar topics (confidence intervals and hypothesis testing). The problem is scored out of 10 points, and it was found that in fall 2015, scores on the embedded problem had mean 7.3 with standard deviation 2.4 and in fall 2016, the mean was 7.2 with standard deviation 2.7, leading up to conclude there was no difference in scores on this common assessment after adoption of the open textbook.

In spring 2017, we compared DFW rates with spring semester 2016. Setting aside one honors section of MATH 2210 and three sections of the course where the open text was piloted, we found a DFW rate of 36.9% in spring '16. The corresponding DFW rate in spring 2017 (setting aside one honors section of the course) was 32.1%; this borders on a statistically significant decrease in DFW rates relative to the previous spring (two-sided p-value of .155).

There were a total of seven instructors who taught MATH 2210 in both spring 2016 and spring 2017, and so we once again compared DFW rates instructor by instructor. The findings are below.

Instructor	DFW grades/total students in spring '16	DFW percentage	DFW grades/total students in spring '17	DFW percentage	p-value
1	17/47	36.2%	26/57	45.6%	.33
2	7/26	26.9%	16/62	25.8%	.91
3	54/100	54.0%	32/62	51.6%	.77
4	20/70	28.6%	13/64	20.3%	.27
5	10/35	28.6%	6/32	18.8%	.35
6	12/35	34.3%	7/32	21.9%	.26
7	8/34	23.5%	20/64	31.3%	.42

Generally, we see small upticks in student success rates at the instructor level.

To evaluate students' satisfaction with the open textbook we administered a Qualtrics survey in fall 2016 and spring 2017. We wanted to measure student satisfaction with the open textbook used and we also wanted to determine what role if any that textbook costs play in students' course selections. We summarize the results of some of the questions on our survey below.

The OpenStax textbook contributed to my understanding of the course material.

Fall 2016 result:

Answer	%	Count
Strongly agree	23.64%	13
Agree	38.18%	21
Neither Agree nor Disagree	16.36%	9
Disagree	7.27%	4
Strongly Disagree	14.55%	8
Total	100%	55

Spring 2017 result:

Answer	%	Count
Strongly agree	15.38%	10
Agree	44.62%	29
Neither Agree nor Disagree	15.38%	10
Disagree	10.77%	7
Strongly Disagree	13.85%	9
Total	100%	65

Which version(s) of the OpenStax textbook did you use? Select all that apply.**Fall 2016 result:**

Answer	%	Count
Free pdf	60.00%	33
iBook	7.27%	4
Printed copy	29.09%	16
Digital copy in Webassign	36.36%	20
No textbook used	0.00%	0
Other (specify)	0.00%	0
Total	100%	55

Spring 2017 result:

Answer	%	Count
Free pdf	54.69%	35
iBook	6.25%	4
Printed copy	35.94%	23
Digital copy in Webassign	43.75%	28
No textbook used	3.13%	2
Other (specify)	3.13%	2
Total	100%	64

We were surprised to see more demand than anticipated for a physical copy of the text. We had initially assumed that approximately 10% of students would want a physical copy, but this figure ended up being significantly higher.

How does the quality of the OpenStax textbook in this course compare with traditional textbooks you have used in other courses?**Fall 2016 result:**

Answer	%	Count
The OpenStax text is significantly better	25.45%	14
The OpenStax text is somewhat better	21.82%	12
The OpenStax text is about the same	18.18%	10
The OpenStax text is somewhat worse	12.73%	7
The OpenStax text is significantly worse	12.73%	7
No opinion	9.09%	5
No textbook was used	0.00%	0
Total	100%	55

Spring 2017 result:

Answer	%	Count
The OpenStax text is significantly better	15.63%	10
The OpenStax text is somewhat better	12.50%	8
The OpenStax text is about the same	29.69%	19
The OpenStax text is somewhat worse	17.19%	11
The OpenStax text is significantly worse	14.06%	9
No opinion	7.81%	5
No textbook was used	3.13%	2
Total	100%	64

For me, textbook costs are a determining factor in my selection of courses.

Fall 2016 result:

Answer	%	Count
Strongly Agree	24.53%	13
Agree	22.64%	12
Neither Agree nor Disagree	26.42%	14
Disagree	13.21%	7
Strongly Disagree	13.21%	7
Total	100%	53

Spring 2017 result:

Answer	%	Count
Strongly Agree	20.31%	13
Agree	9.38%	6
Neither Agree nor Disagree	21.88%	14
Disagree	31.25%	20
Strongly Disagree	17.19%	11
Total	100%	64

On at least one occasion, I have not purchased a required textbook for a course in which I enrolled.

Fall 2016 result:

Answer	%	Count
Yes	61.11%	33
No	38.89%	21
Total	100%	54

Spring 2017 result:

Answer	%	Count
Yes	57.81%	37
No	42.19%	27
Total	100%	64

Based on our data, we could reasonably conclude that somewhere between 30 and 45 percent of this student population freely admits that textbook costs directly influence the courses they choose to take, and this fact is corroborated by approximately 58% of the students admitting to not having bought a required textbook on one occasion. This figure seems consistent with figures that were quoted at the grant’s kick-off meeting.

Based on my experience using the open textbook in this course, I would choose to take other courses that use open source textbooks in the future.

Fall 2016 result:

Answer	%	Count
Strongly Agree	42.59%	23
Agree	25.93%	14
Neither Agree nor Disagree	16.67%	9
Disagree	3.70%	2
Strongly Disagree	11.11%	6
Total	100%	54

Spring 2017 result:

Answer	%	Count
Strongly Agree	34.38%	22
Agree	23.44%	15
Neither Agree nor Disagree	23.44%	15
Disagree	10.94%	7
Strongly Disagree	7.81%	5
Total	100%	64

We anecdotally observed some complaints about the OpenStax textbook (specifically in regard to the table of contents and the overall writing style), but students generally gave positive ratings to the textbook. If we were going to redo this study, we would consider asking students to self-report a projected grade in the course to see if course outcome was correlated in any way with the rating of the textbook.

4. Sustainability Plan

The original materials to accompany the OpenStax textbook are hosted in three locations. A Merlot site (<http://www.merlot.org/merlot/viewMaterial.htm?id=1298954>) makes the open materials accessible to the population at large, while the materials are also hosted locally for Augusta University students at <http://spots.gru.edu/nsmith12/openstats/>. Additionally, the team created a number of problems in WebAssign that can be used to supplement the open textbook; these problems can be found through various keyword searches in WebAssign (Augusta University), and instructions for finding these extra problems can be found on the Merlot website.

Many of the supplemental materials created for the course (in particular the instructor/student lecture notes which accompany the text) can also be downloaded in .tex format which allows easy editing and redistribution of the materials in accordance with the Creative Commons license. The WebAssign materials and the lecture notes will require little to no maintenance.

We anticipate continuing to use the open textbook in academic year 2017-18, and then reevaluating its continued use on a year-to-year basis.

5. Future Plans

Since we will continue collecting data from our Qualtrics survey each semester, and since the department is going to continue using the OpenStax textbook in academic year 2017-18, we will be able to better assess student satisfaction with the open text and materials. Further, the small changes in the DFW rate in MATH 2210 could over time prove to be a statistically significant effect.

We also anticipate that at least one member of the grant team will give a presentation about our experience with the open textbook at a regional conference. Further, if the department opts to continue long-term with the open textbook, we will continue administering the existing

survey and we will continue tracking DFW rates to see if there is in fact a sustained statistically significant effect on DFW rates both overall and when controlling for the course instructor.

However, as stated earlier, perhaps the most significant future development to arise as a result of this project is an increased faculty awareness of both the availability of open materials in mathematics as well as the effect of increasing textbook costs on the students. Two members of the grant team have foregone a traditional textbook in favor of a low-cost alternative in an upper-level course, one member of the department not on the grant team has done the same, and one member of the grant team has chosen an open textbook for use in a new junior-level statistics course that will be offered for the first time in academic year 2017-18.

6. Description of Photograph

The photo features the four current team members. From left to right, the team members are:

Dr. Christopher Terry, instructor of record

Dr. Neal Smith, team lead and instructor of record

Ms. Marvalisa Payne, instructor of record

Dr. Robert Scott, instructor of record