Affordable Learning Georgia Textbook Transformation Grants

Final Report

Date: 12/23/2016

Grant Number: 178

Institution Name(s): University of North Georgia

Team Members (Name, Title, Department, Institutions if different, and email address for each):

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Project Lead: Minsu Kim

Course Name(s) and Course Numbers:

1. *College Algebra; Math 1111*
2. *Pre-Calculus; Math 1113*
3. *Elementary Statistics: Math 2400*
4. *Calculus II; Math 2460*

Semester Project Began: Spring 2016

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

Average Number of Students Per Course Section: 30

Number of Course Sections Affected by Implementation: 23

Total Number of Students Affected by Implementation: 581

1. Narrative

This project had a direct impact on 581 students and saved them a significant amount of money [$48,717 to $81,965] in four mathematics courses (College Algebra, Precalculus, Elementary Statistics, and Calculus II). We felt that we accomplished our main goal of this project in replacing high-cost required textbooks by high-quality and affordable instructional materials in the following two categories:

1. At zero cost to 465 students: We have incorporated chosen open textbooks, a free computerized homework and quiz delivery and grading system (WeBWork). Depending whether students buy an e-version, or purchase a hardcover copy, the savings were $41,328 to $70,567. The use of WeBWorK to develop the homework and quizzes was thoughtful and allowed for ease of grading, supplementing the textbook homework and quizzes, and continued support and implementation for future courses.

2. At a reduced cost (20%-50%) for 116 students: These students were in four sections where an open textbook is chosen together with a commercial homework and quiz delivery system (WebAssign) which cost $35 per student. Depending whether students buy an e-version, or purchase a hardcover copy, the savings were $7,389 to $11,409.

Thus, the total savings for the 581 students involved in this project was $48,717 to $81,965. Students expressed a more positive and satisfactory opinion about the course having a free textbook and a free or reduced cost homework program available to them from day one of the semester. Overall, they were also generally pleased with the content and examples of the selected textbooks.

Transformative impacts on students involved in this project include relevance, free and/or reduced cost of the material and presentation of the resources. The chosen open resources and constructed materials (short video lectures, notes, open textbooks materials and videos) were mapped to the objectives and topics of each of the four courses involved in this project. This was carefully done to maintain syllabus consistency and provide better capacity to meet learning goals of each course. In some of the courses materials were accessed through D2L and in others, local shared class files were used to post course materials.

Students on four sections of college algebra had the opportunity to access auditory and visual approaches which supplemented the lectures as well as provided additional review. In general, all courses have access to for videos and other resources stated in the syllabus.

One of the main outcomes of this project is that all instructional materials were made available to all students in the four courses from day one of the semester. As presented in the qualitative analysis section, having free resources available increased student's retention and their progression in the course. It also raised their awareness regarding resources that available to them at no or minimal cost.

Having ALG, OpenStax, and other venders to locate resources was very beneficial to each professor and in response, to students. For our team, the transformation was an opportunity to

locate and evaluate new resources for courses involved in this project and for other future courses where open resource implementation is possible.

A challenge in implementing the project is to get students adopted to the limitations in using WeBWorK for students who are familiar with other commercial system that was used in previous course. Commercial systems usually have many rich features that are not yet available in WeBWorK. For example: math palette entry for symbolic questions; graphing tools students can use; links to sections of the e-text right on questions; links to animated mini-lectures (with sound); etc. We feel that some of the commercial features are too much for the students and WeBWorK have the necessary features that can support students' learning process. WeBWorK provides students with immediate feedback on the correctness of their answers, WeBWorK encourages students to make multiple attempts until they succeed. WeBWorK can present and grade any mathematics calculation problem from different mathematical courses. As with a commercial system, students usually take some time to learn the syntax and format of the software.

Our team felt that this project has given them the freedom from the restriction of using one assigned textbook and gave them the opportunity to improve education quality and student's learning by providing easy access to not just one, but several valuable textbooks and supplement materials with zero or minimal cost to students.

Our future-plans in using open resources will be mixing and combining materials from different textbooks to come up with a new textbook tailored to our students' needs.

By looking more closely at some of the homework problems developed in WeBWorK, we found some errors and things that needed to be improved. We also realized that we needed to put more time and effort to create problems that are compatible with the selected textbook. Faculty involved in this task felt they gained experience and felt the sense of ownership when developing WeBWorK problems, quizzes and tests that can be used in future courses. Faculty who use our product in future OER based courses will have better selection of WeBWorK problems. Moreover, with the experience gained by our team in open resources and learning about available resources, some of us will consider using different textbook for future classes with additional instructor designed content that better suits our needs. In fact, one of our team members changed the proposed Statistics textbook to a different one when he taught the course in Spring2016.

We also noticed that students tend to have a hardcopy of the textbook especially if it is not expensive. As a faculty, we felt that in-class activities and homework discussion can be done more efficiently when students have a tangible hardcopy in their hand. Hardcopy version of the textbook usually average $35. In the future, we will encourage students to purchase a hardcopy of the book. Students in the sections of college algebra using WebAssign displayed satisfactory progress on homework strictly by using the online program resulting in a complementary net output per student when using this approach.

2. Quotes

- "The use of webwork and free textbook was fantastic! I am a nontraditional student and I pay for schooling myself. So, when Dr. Das told us of the free textbook and web based program we would use during his calculus 2 course, I was ecstatic. The average cost of a textbook is roughly $150.00 and it is a cost added to already rising tuition costs. As one can imagine it is difficult enough to put yourself through school whilst raising a family. Professors, such as, Dr. Das are the few on the side of the students that REALLY want to help people of any age achieve their goals and I hope that these types of trends continue well into the future, and that other additional savings might be allocated as well."

- "This semester I enjoyed having a free class. At the beginning of the semester, I thought I was going to struggle without having a hard copy text book. I didn't understand how to use WebWork, but then began to really appreciate the way it helped me learn. Being a freshman in college and paying for tuition, it was a treat to not have to pay for another textbook. On WebWork, I liked being able to see if I got the answer correct as soon as I submitted it. Overall, this has a been a great class and learning opportunity."

- "I enjoy and appreciate the easy accessibility of the online textbook and the fact that it is free of any charges."

- "This paragraph is written in support of the use of Webwork in the Mathematics Department here at the University of North Georgia. I have had the opportunity the last two semesters to assist students and actually solve several of the problems in Calculus I and Calculus II. Webwork provides problems that are challenging for student to do. Webwork also provide students with additional practice and practice makes perfect for students who are trying to learn challenging material. Webwork give student immediate feedback if problems are done correctly. As a math tutor, I would encourage other colleges to use Webwork."

- "The textbook I used in this course was a free to download book from APEX Calculus provided by my professor. I found the book to be very useful and informative, usually with both a comprehensive variety of clearly demonstrated examples for each lesson and a thorough explanation of the topic at hand as well as many practice problems and solutions. However, there were a couple problems over the course of the semester which the book did not cover in sufficient detail to solve."

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: **581**

- Positive: **62.78 %** of **581** number of respondents
- Neutral: **20.41 %** of **581** number of respondents
- Negative: **16.81 %** of **581** number of respondents

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?

The overall outcomes and grades in the semester(s) of implementation over previous semesters positive.

Choose One:

- **X** 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?

The overall comparative impact on Drop/Fail/Withdraw (DFW) rates in the semester(s) of implementation over previous semesters positive?

Drop/Fail/Withdraw Rate:

26.85 % of students, out of a total **581** students affected, dropped/failed/withdrew from the course in the final semester of implementation.

Choose One:

- **X** 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 evaluate this project, we have collected data from three different data sources: Drop, Fail, Withdraw (DFW) rate from Banner Web. This data will then be cross tabulated along with the preliminary assessment and Cumulative Final exam results.

Course	Total no. of stud. Registered	Withdraw %	A/B/C/D	Pass %	Fail % Individual Scores are less than 60%
College Algebra (Math 1111)	175	19.43 %	23/21/40/23	61.14 %	18.88 %
Pre-Calculus (Math 1113)	90	24.44%	14/21/16/7	64.44 %	11.11 %
Calculus II (Math 2460)	104	34.61 %	37/5/13/3	55.76 %	9.61 %
Elementary Statistics (Math 2400)	212	27.83 %	30/38/44/11	58.02 %	13.21 %

All percentages in the chart above are based on the total number of students registered for each course since the first week of the semester, found in column two. The number of students who passed with each letter grade, A, B, C, or D, are displayed in column four. No comparison was made between passing/failing and the number of students who completed the course with a letter grade (not a W / WF). The percentage of students who completed each semester can be determined by subtracting the Withdraw % from 100%.

In total, 581 students registered for all four classes. A total of 156 students withdrew, producing combined average withdrawal rate of 26.85%.

i) **Technological Competency:** The students' Internet skills, retrieving and managing information via technology was evaluated twice during the semester via assessments through D2L. Data like how often and how long a student is logged in to the online learning system WeBWorK or accessing OpenStax text books and how that corresponds to their successful completion of the course. We found the expected grade of a College Algebra student under the ALG Project was high C or a low B. Whereas the expected grade of a Pre-Calculus student under the ALG Project was a low B. We also found that the expected grade of a Calculus II student under the ALG Project was a high B. And the expected grade of an Elementary Statistics student under the ALG Project was a high B to low A.

ii) **Students' feedback through survey:** Students were asked to participate in anonymous surveys about the overall effectiveness of the "no cost" courses twice during each semester. For each of the questions the student responded saying whether they **never (1), rarely (2), occasionally (3), regularly (4) or always (5)** participated or practiced the objectives of the survey on a weekly basis. The following tables describes the weighted means of the responses to some of the survey that directly correlates with the ALG project.

A. How often do you use material posted on D2L or shared class files?

		Mean beginning of the semester	Mean end of the semester
College Algebra		4.42	4.28
Pre-calculus		4.38	4.03
Calculus II		3.83	3.83
Elementary Statistics		4.44	4.23

B. How often do you use the online homework system?

		Mean beginning of the semester	Mean end of the semester
College Algebra		4.56	4.61
Pre-calculus		3.51	3.59
Calculus II		4.57	4.51
Elementary Statistics		3.92	4.28

C. How helpful is your online homework for learning?

		Mean beginning of the semester	Mean end of the semester
College Algebra		4.21	4.20
Pre-calculus		3.51	3.41
Calculus II		4.45	4.37
Elementary Statistics		3.05	3.34

D. How helpful is your textbook for learning?

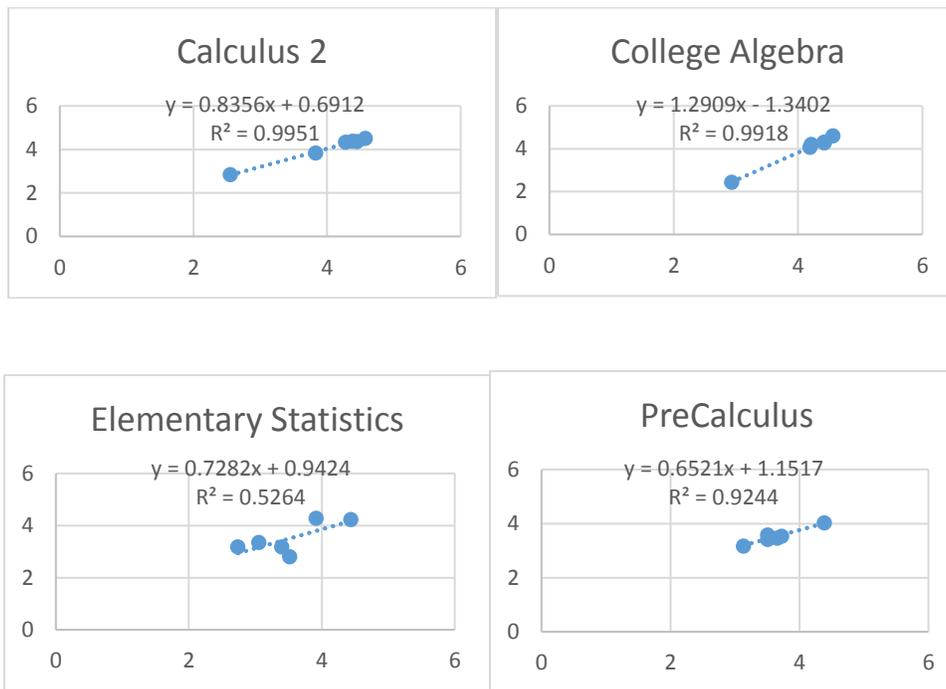|		Mean beginning of the semester	Mean end of the semester
College Algebra		2.93	2.44
Pre-calculus		3.13	3.17
Calculus II		2.51	2.84
Elementary Statistics		3.51	2.78

E. Overall, are you satisfied with the educational materials, for example, a text book, WebWork or worksheets?

		Mean beginning of the semester	Mean end of the semester
College Algebra		4.19	4.07
Pre-calculus		3.72	3.53
Calculus II		4.28	4.33
Elementary Statistics		3.4	3.18

F. Overall, are you satisfied with your learning experience in this class?

		Mean beginning of the semester	Mean end of the semester
College Algebra		4.42	4.31
Pre-calculus		3.66	3.47
Calculus II		4.38	4.38
Elementary Statistics		2.74	3.18

We also have performed regression analysis with these data to see whether the ALG project has any positive impact on the outcomes over the aforesaid qualitative traits of the subjected students. Between the two surveys, the first done early in the semester and the second done in the weeks preceding final exams, we have seen steep increase in the quality of the responses. We are providing four linear regression graphs demonstrating the correlation between student usage of the different facets of the ALG project and the likelihood of getting desired responses about the qualitative traits.

Calculus 2
$y = 0.8356x + 0.6912$
$R^2 = 0.9951$

College Algebra
$y = 1.2909x - 1.3402$
$R^2 = 0.9918$

Elementary Statistics
$y = 0.7282x + 0.9424$
$R^2 = 0.5264$

PreCalculus
$y = 0.6521x + 1.1517$
$R^2 = 0.9244$

As shown in the above graphs, all four courses brought under the ALG banner have seen positive slope in the line of best fit. The impact on learning outcomes for these classes, as based on student experiences in zero/partial cost settings, was confirmed and investigators found a strong betterment of student responses. The range of betterments varied between 33% and 52% between the two surveys done at the beginning of the semester and at the end of the semester. A t-test has revealed that there is enough evidence at the significance level of 0.0001 (99.99%) that the ALG project implementation has improved the quality of student learning outcomes, student retentions during the academic year of 2016.

4. Sustainability Plan

We will share materials (open textbooks, class notes, WeBWork, or OpenStax in WebAssign) for the four courses, College Algebra, Pre-Calculus, Elementary Statistics, Calculus II, with math instructors who are interested in OER. The project team members will keep the original copy of the learning material and will maintain and update materials as needed.

5. Future Plans

We expect that we will continue to improve and adopt the materials for the four courses. According to the positive results of this project, we have a plan to adopt open textbooks for the other courses and encourage faculty to adopt OERs. We anticipate to present our results at a conference.

6. Description of Photograph

- *(left to right) Mr. Thomas Hartfield instructor; Dr. Hashim Saber, instructor; Dr. Bikash Das, instructor; Dr. Minsu Kim, instructor and proposal investigator.*