Affordable Learning Georgia Textbook Transformation Grants

Final Report

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Grant Number: 356

Institution Name: Georgia Highlands College

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Course Name and Number: Elementary Statistics (Math 2200)

Semester Project Start Date: Spring 2018

Semester of Implementation: Fall 2018

Average Number of Students Per Course: 23

Number of Courses Assessed: 18

Number of Students Effected by Implementation: 407

1. Narrative

A. Key Outcomes

The purposes of this project were to outline, develop and implement an open educational resource (OER) for the Elementary Statistics course (Math 2200), at Georgia Highlands College, a course covering introductory topics in Statistics. This course is a suggested course for our

undergraduate non-stem majors, a required course for GHC's BBA, BSN and BSDH majors, and serves as a popular elective for our business administration and general studies students.

The selection of an OER was easy identified due to the previous work with ALG Open Mathematics grants. Some of the previous material developed by two of the previous participants in that grant were used to develop the new material for this grant. With an emphasis on no-material costs for the course, the two subject matter experts and instructional designer worked to assemble a collection of scholarly resources, focused on new power points, extra notes, closed-captioned videos, practice problems and homework problems to give students a multimodal learning system. The bulk of our manually constructed OER aligned with the Open Stax book, Introductory Statistics, https://openstax.org/details/books/introductory-statistics. The librarian for this grant was able to post most materials, excluding the practice and homework problems, to a libguide for easier reference. This course overhaul involved creating a robust D2L course so that it could be used in face to face and online courses. A primary goal was to create practice and homework problems that were included with the material so students didn't have to purchase a third party software. The grant also focused on developing the course to use free websites to solve the practice and homework problems and negating the use of the expensive TI-83 or TI-84 calculator. Both of these cost saving measures meant students could begin the course on the first day of class with no additional costs.

The newly constructed practice problems were created using the quiz format in D2L and were paired with a video showing the steps on how to complete at least one of the problems in all fourteen submodules. Additionally, homework problems were created using the quiz format and provided numerous versions for students to test their knowledge in the fourteen submodules. The project lead was able to help troubleshoot any issues through email and video tutorials to help the faculty feel comfortable with them.

The course was divided into four modules to help improve the understanding and connections of the topics. Within each module, the material was broken down by overall introduction to the topics, projects and discussions, submodule material, and conclusion. Here is the modules with submodules:

Module 1: Basic of Statistics, Statistics Vocabulary, Types of Data, Sampling Techniques, and Qualitative Data

Module 2: Frequency Distributions, Descriptive Statistics, Probability and Normal Distribution

Module 3: Confidence Intervals (Z-interval), Confidence Intervals (T-interval), Hypothesis Testing and One Mean Z-test, and One Mean T-test

Module 4: Chi-Square Goodness of Fit, Linear Regression, and Analysis of Variance (ANOVA)

Each submodule was broken into four parts to help students understand the flow of the material and provide consistency: Submodule Introduction, Power Points and Extra Notes for

Submodule (including closed-captioned videos), Practice Problems for Submodule (including closed-captioned videos), and Homework for Submodule.

B. Challenges and Accomplishments

The course design, by the course designer and two Mathematics professors, was user friendly and written to be ADA compliant. Consistency was used in the design process to help students navigate the course. The challenges were numerous and were often unexpected but we were able to recover. D2L can be cumbersome to use if not familiar with it. The actual course set-up was easy but building the homework and practice quizzes was difficult. It is a precise activity and easy to make mistakes which complicate student's understanding due to typos or wrong answers. We did have someone test the homework prior to implementation but realized that they were not able to complete every problem due to randomization. The format of the advanced homework problems challenged the students and many of them were not familiar with solving problems in multiple steps. It was unfortunate since these problems were designed as a check to accompany the process map. For students who didn't invest the required time in the course, they struggled more than previous semesters. I feel that when we used Web Assign, many students googled the answers to the questions and didn't learn the concepts. By creating these problems, they had to rely on their own knowledge. Another issue was the homework had two attempts and would not give the answers of what the students missed. It was not a huge issue until the advance statistical methods when small mistakes can make a huge impact on the rest of the problems. In the future, we will make the homework more precise so they can see the exact problem they miss and can correct it. One issue was the unpreparedness of the students as the material got harder. When concepts were re-visited in the last sections, students scrambled to recall the material. We are not sure if it is students' lack of understanding the material initially or rushing through the material just to get it done. While it has happened in the past, it was very apparent on the projects and exams. One final challenge was the use of the free websites. One of the ANOVA websites we were using began to not accept data it had previously accepted. We were able to quickly identify a new one and have the students use it. It would be wonderful to create our own websites but that is time and cost prohibitive.

While there were challenges, there were many accomplishments, as well. Being able to provide the students with a no-cost course was extremely gratifying. Students were able to start working on material the first week of class which made an impact on the online courses. The quality of the material was excellent and gave students a solid reference outside the textbook. The videos made helped with providing conceptual materials as well as examples. Students often remarked in the discussions about how the videos helped them. We have never used a standardized set of flowcharts for the advance statistical methods in the past but added them to the redesigned course. Each flow chart was color-coded to the type of the statistical tests and had the various steps that were needed to solve the problems. They have been used often

by the students to understand the concepts and the homework. Students didn't complain about the workloads in the courses which was often the case in previous course surveys.

The course and practice problems from the course management system were replicated into a public facing website. Students can navigate the content and receive feedback from the practice problems without a password or being enrolled. For instructors, this course is freely available for use and adaption through Springshare's Library Guides community platform. Library Guides is a common content management system used throughout academic libraries so the course should be widely accessible. Being available to the academic community and free to any student allows this course to have a wide reach:

https://getlibraryhelp.highlands.edu/math2200

C. Transformative Impact for the Instruction

While the students' viewpoint is extremely important, we also wanted to get feedback from faculty teaching the course. Our pilot group of six faculty members teaching the course for the ALG grant were required to complete a survey after each module to give feedback on their experiences. The sample size was very low with 17 responses with the threshold for satisfied was recorded as "satisfied" and "somewhat satisfied"

Faculty Feedback:

Each faculty member was given the same survey four different times in throughout the semester. All of the faculty accessed the homework created and most used the power points. The projects, videos, and textbook were not used by everyone but were not necessary to use based on how the course was built.

Homework and Practice Problems: The overall satisfaction for the homework was 76.5% with some concerns about students not being able to see their answers and multiple-choice format that were difficult to display the entire problem. To help fix these problems, faculty could show the students the answers for the homework if they wanted to. Since the multiple-choice format of the questions was difficult to fix in a live environment, new questions have been redesigned for Spring 2019 and the old questions will be added to the practice problems. In future semesters, the midterm and final exams will be used in one semester and then turned into homework problems for the next semester. This practice will increase the homework question bank and keep the integrity of the exams. Questions were not asked in the survey about the practice problems which was an oversight. Most faculty are using them as a non-graded assignment for students to feel more comfortable with the material.

Power Points: 94% of the faculty were satisfied with the power points. Since we were teaching the same material we had previously taught, faculty could have used their own personalized power points if they desired.

Videos: 82% of the faculty were satisfied with the videos. The videos were design to supplement the online courses but were offered to anyone for use. More videos were added throughout the semester based on student discussions, student emails, and faculty survey feedback. This practice helped fill in the gaps that were not apparent when the course was being built.

Textbook: The opinions about the textbook were varied with the range from satisfied to dissatisfied. The textbook was mainly a back-up reference to all the other material. Most of the homework and practice problems were from the textbook with different versions of problems being created. This textbook has always had mixed reception in the Mathematics department at GHC.

Website and Calculator: The use of the free websites was popular with some faculty but not used with other faculty. For the online courses, the faculty gave the choice to use either tools. Some faculty only wanted to use the calculator and Excel to teach the material. There was one slight issue with the ANOVA website not working for some of the problems. A new website was discovered and passed along to students and faculty.

Pacing of the Course: The course was built in the four modules to help with the format of four exams. Most faculty, 64.7% found the pacing of the course acceptable while the other group found the pacing of the course too slow. Many faculty felt that the first Module was too little material to test on so they included parts of Module Two. In the future, faculty can change the submodules to make their own modules so they can dictate the flow of material.

Faculty Quotes about Student Performance:

Faculty is the best gauge of how well the course is running on the different sites and instructional formats. One question on the survey ask, "How are your students doing in the course compared to previous semesters with other material?". Here are some of the responses which showed that there was not definite answer about if the new course material was successful:

"Overall, just a bit worse than previous semesters. Granted this could be due to me adjusting to the order and set up of the course."

"Better, I have been able to stay on or ahead of schedule."

"The students had a slightly tougher time with this test, but that is mostly due to the adjustment for being asked how and what the numbers meant. It was about a 5% decrease in scores from spring."

"The students have similar grades on the first exam compared to previous semesters teaching."

"My students did slightly better on the Module 1 test than my previous course students."

"My students did better on Module 1 and Module 2. However, they seems to be doing worse on Module 3."

D. Transformative Impact for the students and their performance

Student Feedback:

Each faculty member was asked to give a standardized survey to their students. Responses was voluntary and extra credit could be awarded if the faculty felt strongly about it. The overall sample size was 227. Again, we narrowed the definition of satisfied to include only responses as "satisfied" and "somewhat satisfied".

Homework and Practice Problems: The overall satisfaction for the homework was 81% with concerns about not being able to see their answers and multiple-choice format that were difficult to display the entire problem. This information was used to redesign the questions for future semesters. Students also requested more practice problems that will be added in the future. A few students wanted a format of homework like MyMathLab that they used in previous courses.

Power Points: 92% of the students were satisfied with the power points. The only comment about the power points was for there to be more example problems.

Videos: 85% of the students were satisfied with the videos. The videos might not be needed for the face to face classes so the students might have not viewed them and could not respond about the quality.

Textbook: 51% of the students were satisfied with the textbook and 10% bought the hard copy to use. Again, the textbook was mainly a back-up reference to all the other material but 30.4% of students said they used it during the semester. A few students complained about the textbook not being easy to understand.

Website and Calculator: The use of the free websites was popular with some students but other students were adamant about using the TI-83 or TI-84 calculator. Students never really gave their reasons for a preference but were very forthcoming about what they were using. We didn't include a question about both formats in the survey since some faculty never introduced the use of the websites.

Pacing of the Course and Overall Grade Satisfaction: Over 93% of the students felt the pacing was acceptable. This finding is interesting since only 64.7% of faculty found the pacing of the course acceptable. When the students were asked about grade satisfaction, 76% of them replied that they were happy with their grades.

2. Student Quotes

Students were presented with two open-ended questions to gauge what they would change about the course.

Student Quotes on what is missing from the course:

"I don't believe there is anything really missing from the course. I found it to be pretty straightforward."

"The quiz formats were very difficult to navigate."

"The homework. I prefer my math lab because it gives you opportunities to keep practicing and it also shows you what you did wrong with each problem. So I have a better understanding with the material that we are learning instead of doing the homework and being told my answer is wrong but knowing how or why"

"I see no reason to fail due to something missing. I actually have more resources than I thought I would have when registering for Statistics."

"More examples"

Student Quotes on what you would add to the course:

"More chances on homework."

"More examples on the power points."

"I felt as the projects were a tad excess. Although helpful they compounded and made things at times overwhelming. They did help with reinforcing and applying the material we learned and being that their grade weight was small missing one wasn't a critical mistake and your grade won't suffer terribly."

"Nothing really needs to be added."

"I think the course is great as it is."

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?

*Since the textbook was used as an alternative reference, the overall student opinion was an average of the videos, power points, and homework made from the course.

Total number of students affected in this project: _

- Positive: __86__ % of __227__ number of respondents
- Neutral: __10_ % of __227___ number of respondents
- Negative: __4 _ % of _227____ 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?

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)
- __X_ 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:

__24_% of students, out of a total _407_ 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)
- __X_ Negative: This is a higher percentage of students with D/F/W than previous semester(s)

3b. Narrative

- *In this section, summarize the supporting impact data that you are submitting, including all quantitative and qualitative measures of impact on student success and experience. Include all measures as described in your proposal, along with any measures developed after the proposal submission.*

DFWI Rate

	Fall 2017	Spring 2018	Fall 2018
Math 2200	85/460 (18.48%)	111/612 (18.14%)	97/407 (23.83%)

Table 1. Comparison of Pre-and Post-transformation DFWI Rates

DFWI Rate. As noted in Table 1 above, there was an 5.35% increase in overall DFWI rate in Math 2200 from the previous academic year and a 5.69% increase in DFWI from the previous semester. There was not a statistically significant difference between the percentage of DWFI rates between Fall 2017 and Fall 2018 (Z-value = -1.9305, p-value = .0536) at the 0.05 level of significance. It should be noted the p-value is very close to the level of significance. Similar results were not seen with Spring 2018's rate being statistically significant different from Fall 2018's rate (Z-value = -2.2071, p-value = .0271). There was a slight difference between enrollment numbers from Spring 2018 and Fall 2018 where more students enroll in Math 2200 in the spring. This would account for difference in the enrollment numbers. Since the increase in the DFWI rate was significant for Spring 2018 and was slightly not significant for Fall 2017, it could be attributed to reasons ranging from instructors' comfort with the new material, students' ability to navigate the new material, and overall structures of the instructors' courses.

Issues with WebAssign. In previous semesters, the MATH 2200 course used WebAssign exclusively for homework. The online versions of these courses used WebAssign for online testing. While designing the course, it was discovered that students from previous sections of the courses had posted many of the WebAssign questions including final exam questions on a third-party website that aids students in finding answers. This practice could have lead to a decrease in overall grades since the new exam questions were timed and would be difficult to get immediate feedback.

Access of Student Learning Outcomes: While we had hoped to tie every homework question back to an SLO, we ran out of time before fall semester began. Our focus turned to the existing assessment as a measurement for the success of the OER materials. For GHC assessment of general education student learning outcomes associated with MATH 2200, students were asked to calculate and interpret the measure of position, Interquartile Range, as a common question given on the exam after teaching descriptive statistics. Overall, 91% of the students were able to calculate and interpret the Interquartile Range correctly in Fall 2018. This rate, although slightly lower than Fall 2017, still exceeds the performance measure of 75% by more than 10%. Secondly, students were asked to interpret information graphically using a boxplot as a common question on the exam given after teaching descriptive statistics. Overall, 79% of the students were able to interpret the boxplot correctly in Fall 2018. Again, this rate, slightly lower than Fall 2017, still meets the performance measure of 75%. While some disparity is not uncommon with the assessment from year to year, the lower performance measure could be explained by various reasons such as only the six full-time faculty members that were part of the grant were required to use the newly developed materials in Fall 2018, grading

inconsistency among the instructors, and different population of students with varied mathematical backgrounds.

4. Sustainability Plan:

This project has shown the importance of producing quality material and resources for students and not relying on third party software and instruments. This process to designing one course was incredibly time consuming and strenuous at times due to constant updates, continuous course building, and overall maintenance of the course. D2L can have an extensive learning curve when developing the problems and creating the materials. The challenges faced by other faculty were usually issues addressed previously but need to be repeated often. Providing faculty with a master course has proven to be an effective way to disseminate the materials quickly and easily. A training session was held before the semester for faculty using the material.   Also, videos were made to reinforce the methods to successfully use the course. While we limited the topics in the course, faculty have seen how easily it is to add new material and topics to their course. There is talk of adding new sections to add more options for faculty to teach.

With the addition of two bachelor degrees that rely on their students to build on their knowledge of statistics, this new course design has helped streamline the topics covered to maximize the continuity of what the students are learning. While faculty have academic freedom to choose how to test and can add any additional activities, the materials and homework problems are providing a substantial base for the students' statistical knowledge.

5. Future Plans

While many of the faculty are onboard with the transformation, we have been met with some resistance from faculty who prefer the third party software. For spring 2019, the Mathematics dean has insisted that everyone use the new course material including the new homework. Our hope is that these faculty will see the benefit to our students and support the new course for future semesters. As the course keeps progressing, the online faculty hope to use a previous semester's midterm and final exam questions as additions to the next semester to help increase the homework base. If the homework problems are being shared by students and don't present an accurate way to fully assess their ability, these problems could be deleted or added to the practice problem sections. More material can easily be added if there are curriculum changes and

While we don't plan to present the material, we do plan to try these techniques in other courses to see if they will impact student success. If we find that we have successfully improved the course enough to show significant change, we will try to publish or present these findings. We are eternally grateful for the opportunity to have been selected and make a difference in

our students' academic careers through this OER. All of the participants have learned a great deal and feel confident in the mission of how OER can impact higher education.

6. Description of Photograph:

The picture included is the main collaborators of the grant. From left to right, the individuals are Elizabeth Clark, Librarian; Katie Bridges, Instructional Designer; Laura Ralston, Professor of Mathematics; and Camille Pace, Assistant Professor of Mathematics.