

Affordable Learning Georgia Textbook Transformation Grants

Final Report

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The final report submission form allows up to five files:

- This completed narrative document (required)
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If multiple files, compress into one .zip folder
- Qualitative/Quantitative Measures data files (required)
If multiple files, compress into one .zip folder
- Photo of your team or a class of your students for future ALG promotions (optional)
- Invoice for the second half of the grant's award amount (optional)

Follow the instructions on the webpage for uploading your documents. Based on receipt of this report, ALG will process the final payment for your grant. ALG will follow up in the future with post-project grantee surveys and may also request your participation in a publication, presentation, or other event.

General Information

Date: 06/18/2020

Grant Round: Fourteen

Grant Number: 468

Institution Name(s): Georgia Southern University, Statesboro, GA

Project Lead: Dr. Beulah Narendrapurapu

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

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Course Name(s) and Course Numbers: Comprehensive General Chemistry (CHEM 1310)

Semester Project Began: Fall 2019

Final Semester of Implementation: Spring 2020

Total Number of Students Affected During Project: 566

1. Narrative

A. *Describe the key outcomes, whether positive, negative, or interesting, of your project. Include:*

- *Summary of your transformation experience, including challenges and accomplishments*
- *Transformative impacts on your instruction*
- *Transformative impacts on your students and their performance*

It has been a rewarding experience to develop the OER material for the 'Comprehensive General Chemistry' course geared towards engineering majors. We have learnt many things through this transformation process, and we are grateful for the support showered by USG. We have curated the content from the OpenStax Chemistry textbook and transformed the material as appropriate for the selected course.

Our first task was to create learning objectives for the several chapters as guided by the syllabus of this course. This effort required identifying the correct HTML file for the OpenStax material. Our library liaison helped us to import the files under LibGuides (library guides) and created a new course for us. This effort needed reshuffling of the content and we modified 21 chapters in OpenStax which were converted to 13 chapters in LibGuides at Georgia Southern University (GSU). This took a chunk of time for PI and Co-PI to decide which topics we would like to emphasize related to learning outcomes of this course.

While doing so, we added content relevant to electrical, mechanical engineering applications. For instance, while discussing redox reaction under the chemical reaction chapter, we incorporated an example to display molten metal in creation at steel mills which very much rely on redox processes and is linked to the chemical and industrial engineering processes.

We have also included figures focused on engineering applications such as use of rechargeable batteries in electric cars where the functioning mechanism is based on electrochemistry connected with electrical engineering concepts. These transformations were quite challenging since it requires critical thinking and through research and awareness of current technological advancements and their connection to basic science. We must say that the process was also very rewarding for us since we will use these findings to teach other general chemistry courses for majors to emphasize the connection with the real world.

Along this line, we have introduced totally new topics which are an extension of basic theory such as 'Modern Materials' under the 'Liquids & Solids' chapter. We have introduced 'Ceramics', 'Composite Materials', 'Polymers' under this chapter to emphasize how understanding phases of substances can lead to synthesizing complex substances. We have complimented the text with visuals/videos to elaborate various interesting mechanisms which link to biomedical, industrial, material science & mechanical engineering processes.

We have also introduced multiple videos (embedded in text) to provide visuals for critical concepts. This endeavor required a thorough search of the database to choose the appropriate ones that we believe will have the highest impact on the students. One thing we realized during the implementation phase was that perhaps creating our own videos will have even more impact on our students as they will be able to connect more with the lecture material and the learning resources. It will be our future goal to develop our own lecture videos.

We also created some new tables to elaborate certain topics such as 'Solubility Rules' which was not provided in a desired format at OpenStax.

Finally, we have created the end of the chapter (EOC) problems focusing on engineering majors. This has been the most challenging task since we created many questions that directly connect chemistry with engineering processes which required both critical and creative thinking. For example, while generating questions for dimensional analysis, we created scenarios such as how a textile company can use basic science/analytical calculation for dying purposes. This relates to mechanical and industrial engineering.

We are happy with our product and feel confident that the transformed materials will not only benefit engineering majors but also motivate diverse chemistry majors to pursue basic science and make an impact at various STEM practices.

The finished product can be seen here: <https://georgiasouthern.LibGuides.com/chem1310>

Transformative impacts on instruction:

Development of the OER material as “Chemistry Textbook” in LibGuides influenced the instruction pattern for CHEM 1310 course in the Spring 2020 semester. Listed below are some points that impacted classroom teaching.

Textbook link: In the syllabus, a link for the textbook was provided to the students for easy access to the course content. While presenting the individual chapter content in class, a specific chapter link was provided in the PowerPoint slides. Chapter front page as it is in the textbook was shown in the starting slide of the individual chapters.

Lecture material: The content in the lecture slides were changed from the previously taught lecture material for this course. Lecture slides reflected the curated content from the textbook. The contents were delivered in the same sequence as they appear in the book pertaining to the learning outcome.

Visual Examples:

(a) With an expectation of retaining some seemingly “critical” concepts, few topics were explained through already embedded videos in the “Chemistry Textbook”. In class, the videos were opened directly from the links in the textbook and theories were explained through visual examples.

(b) A part of the teaching strategy included flipped classroom technique where the students were referred to the links for specific videos in the textbook. They were asked to take notes for those materials to prepare for an in-class quiz (or iClicker questions).

Interactive Simulations: To engage students through an intuitive platform, computer simulations were shown in class to convey the theory. For instance, to explain limiting reactants, a simulation of sandwich preparation was shown. These links are available in the curated resource material and students have access to it.

Chapter problems: Having an accessible text helped show textbook examples within the chapterend of chapter (EOC) examples during classroom discussions. The link for end-of-chapter problems for each chapter was also provided in the learning management system (LMS) for this course. This helped manifold when the instruction transitioned to online medium from face-to-face for covid-19. During office hours, end of chapter problems from the textbook were discussed to improve student’s comprehension of the subject matter.

Transformative impacts on students and their performance:

The no-cost materials ensured that all students had access to the materials from day-1 of the course. The LibGuides textbook had 7132 views during the Spring 2020 semester. During face-to-face instruction up until Spring break, the spikes in the views were around the exam dates from both classes suggesting that students were using the materials to prepare for exams. See Supporting Data for more details.

There was a noticeable drop in the overall DFW rate from Fall 2019 (52%) to Spring 2020 (39%). However, we cannot attribute this entirely to the use of OER materials as the COVID-19 pandemic has impacted the mode of instruction and administration of quizzes and exams in the course. Students who used our OER materials reported stronger agreement that the examples used in the materials directly related to their major and career interests when compared to students that used the publisher-provided e-text.

B. Describe lessons learned, including any things you would do differently next time.

We have curated contents from OpenStax Chemistry textbook and created a useful resource for “Comprehensive General Chemistry” course for Engineering majors according to course learning outcomes. During this journey, we uploaded the OpenStax content onto LibGuides and extensively edited the content. We are happy of the choices we made to include library liaisons to aid us with the work and support us with the technology. In the process, the PIs and co-PIs have learnt how to edit content, equations, figures in HTML and how to make the content accessible. OER has taught us to pay attention to accessibility of the course resources and learn how to add alternate data for figures and tables.

The PI has also realized that actively encouraging students to interact with the textbook and reminding them about the video features in the textbook is important to promote the usage of textbook among the students. To enforce the textbook content, the PI has taken measures such as embedding links to specific LibGuide pages in the lecture Powerpoints, reviewing EOC problems from LibGuides to review for exams and embedding links to the LibGuides textbook in the LMS and homework platforms. The lesson learnt is that promoting the textbook and how its content is different from a traditional textbook is as important to encourage students to get into the habit of reading the textbooks and making a good use of the resource for their success.

We realized that our current end-of-the chapter problems are not grouped according to the topic or encompass various difficulty levels. We want to address this for future semesters. We learnt that students rely heavily on instructor created materials such as videos and PowerPoints. Our future plans include embedding instructor created videos into the LibGuides for selected topics to steer students towards using the materials.

Next time we work on a similar project, we will organize the learning outcomes and identify topics that need to be stressed more and start with those. Also, we would add on the references section simultaneously while editing content.

2. Quotes

Provide three quotes from students evaluating their experience with the no-cost learning materials.

Our quantitative measurement of the no-cost learning materials did not include a free-response question. Hence, we were not able to collect student comments about the materials. We present here the responses collected from an informal anonymous survey about student experience with LibGuides from Summer 2020 semester:

"I used the LibGuides textbook in preparation for my four exams this summer. It was a good reference to better understand the material we learned in our online lectures. The thing I liked most about the textbook is the sample problems at the end of each chapter to help me study for exams. I think the textbook is constructed very well, and I hope we will have more of these types of textbooks for other courses at Georgia Southern like Economics, Physics, and Math, just to name a few. I do think having LibGuides format textbooks will make a difference to student's success."

"It was easy to understand and very clearly formatted."

"I thought this textbook and system worked great! It is definitely the future to keep the cost of books low"

"It was good for note taking and reading ahead; the end of chapter questions were the most helpful; can be improved with more use in the lectures; it definitely should be how information is distributed and will only benefit students in the future."

3. Quantitative and Qualitative Measures

A. Uniform Measurements Questions

The following are uniform questions asked to all grant teams. Please answer these to the best of your knowledge.

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: 190 students in Spring 2020

- Positive: 46% of 30 respondents¹
- Neutral: 41% of 30 respondents
- Negative: 13 % of 30 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)
- ☐ 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:

Depending on what you and your institution can measure, this may also be known as a drop/failure rate or a withdraw/failure rate.

39% of students, out of a total 190 students affected, dropped/failed/withdrew (DFW) from the course in the final semester of implementation.

Choose One:

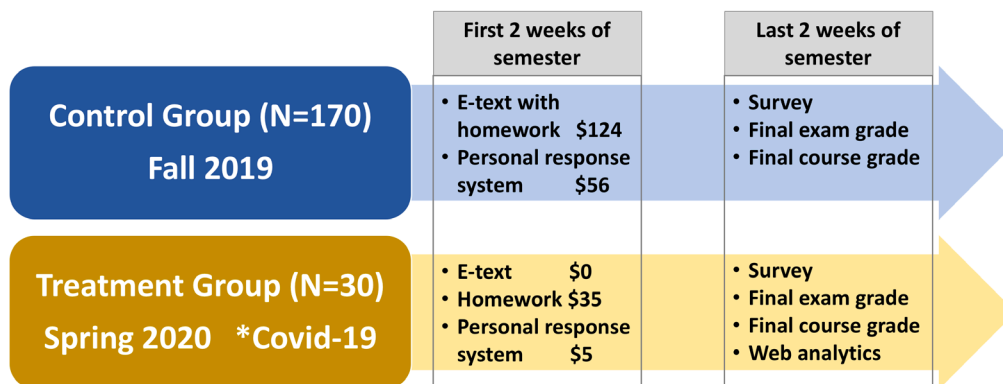
- ☒ Positive: This is a lower percentage of students with D/F/W than previous semester(s)
- ☐ Neutral: This is the same percentage of students with D/F/W than previous semester(s)
- ☐ Negative: This is a higher percentage of students with D/F/W than previous semester(s)

B. Measures Narrative

To determine the impact of the newly designed, low-cost course materials for Comprehensive General Chemistry, we focused on student usage of materials, learning

¹ See discussion of Covid-19 in the Supporting Data file for an elaboration on the response rate (N=30).

outcomes, and student perception of materials. We collected survey and grade data from two cohorts of students (Fall 2019 and Spring 2020; see graphic below) to measure any potential changes. A copy of the survey can be found in Supporting Data.



It is important to note that due to Covid-19, students and instructors for this course experienced a dramatic shift in learning environment, course delivery, and course assessment midway through the Spring 2020 semester. For this project, we were required to change our survey data collection methods from face-to-face (as it was done in Fall 2019) to online collection (Spring 2020) which resulted in a drastic reduction in student response rates to survey items (from 45% to 16% respectively). We also chose not to analyze final exam grade data despite this being highlighted in our proposal. The chemistry department has consistently used the same final exam each semester for comparison of CHEM 1310 sections over time. For Spring 2020, due to concerns about cheating and an attempt to keep the departmental final exam confidential, a new final exam was written and administered entirely online. This meant that final exam scores were no longer directly comparable for analysis. We opted to rely solely on final course grades instead to highlight any learning gains.

Grade Data

The Fall 2019 control group had an overall DFW rate of 52% across two different instructors while the Spring 2020 group had a DFW rate of 39%. While this is encouraging, we are hesitant to attribute this change entirely to the use of low-cost transformed materials. Some confounding factors related to Covid-19 necessitate cautious interpretation of these data and are discussed in the Supporting Data file.

Survey Data

We administered a survey based loosely off the TAUS survey (see Supporting Data) to explore student use and perceptions of the textbook for the course. This would allow us to compare student views of their traditional, publisher-provided e-book to the no-cost LibGuides materials created under the ALG grant. Noticeably more students felt that the LibGuides were critical to doing well in the course in terms of grade (77%) and

homework assignments (77%). They also reported using the internet less often as a resource and using the LibGuides more often to understand material (83%) and solve problems (73%). In contrast, over 25% of students using the publisher-provided textbook report never using their e-book to understand material and solve problems. Lastly, we asked students about a variety of features common to most textbooks. Students using the LibGuides reported far more agreement (50%) with the statement that “the everyday life examples are relevant to my major and my career interests”. This improvement highlights one of our goals for the textbook transformation project - to provide more relevant materials for engineering majors.

Due to complications mentioned previously from Covid-19, we intend to collect the same survey and grade data during the Fall 2020 semester (again with students using the new, low-cost materials) and are hopeful that we will see similar improvements for these students. As we continue to collect survey and grade data, we intend to run statistical analyses (such as Mann-Whitney U) to determine if any of the differences mentioned above are statistically significant. All data collected up until this point is thoroughly outlined in the Supporting Data document accompanying this final report.

4. Sustainability Plan

Describe how your project team or department will offer the materials in the course(s) in the future, including the maintenance and updating of course materials.

The LibGuides textbook will be the textbook that instructors teaching CHEM 1310 will use in semesters starting from Spring 2020. The link to the textbook will be posted each semester on the Folio Desire2Learn platform for all sections of CHEM 1310. The link to the LibGuides textbook will also be included in the Sapling homework platform. Instructors teaching the course will be encouraged to discuss example problems from the LibGuides in their classes and use the embedded videos to support flipped classroom instruction. Students will be encouraged each semester to refer to the embedded videos, worked examples, figures/tables and end-of-the chapter problems.

The PI is the coordinator for CHEM 1310 course and also one of the instructors for the course. The PI will evaluate the content of the textbook from semester to semester based on learning outcomes and will make updates to worked examples, end-of-the chapter problems, video content as needed. The PI will collect student feedback at the end of each semester and add any features that will make the content more beneficial for student success. Any typos or errors that come to the PI's attention will be fixed immediately. Feedback from peers is also an important aspect to consider making the LibGuides textbook better align with the learning outcomes. From time to time, the PI will collect feedback from other instructors teaching CHEM 1310 and the team will make updates accordingly. The

LibGuides textbook will be maintained by checking if all the weblinks and embedded videos are functioning in a timely manner.

Any changes or updates to the LibGuides platform that will affect the LibGuides textbook availability and formatting will be brought to the notice of the PI and other team members by our library liaison (who is also one of the team members) and action will be taken accordingly.

Also, the team plans to continue to collect data from future semesters in order to gain a better understanding of how students interact with the LibGuides and how it contributes to students' success in the course.

5. Future Affordable Materials Plans

Describe any impacts or influences this project has had on your thinking about or selection of learning materials in this and other courses that you will teach in the future.

Currently, the lecture materials for CHEM 1310 are low-cost materials. Our team aspires to move towards no-cost for CHEM 1310 materials by eliminating costs for the homework as well. To achieve this goal, we aim to create question libraries in desire2Learn platform and use the questions on homework, online quizzes and online exams. This would also enable this course to be taught online in the future, providing instructors with easily accessible resources.

As far as additions to the LibGuides is concerned, we will modify the created End-of-the-chapter problems to encompass problems of various difficulty levels. The COVID pandemic forced instruction to move online and enabled instructors to create videos of lecture content. We will include these videos for selected topics. OER Simulations for challenging topics will be selected and included in the LibGuides.

6. Future Scholarship Plans

Describe any planned or actual papers, presentations, publications, or other professional activities that you expect to produce that reflect your work on this project.

We have presented our initial findings of the project in the SoTL Commons Conference in Spring 2020 and the work is published in the [Georgia Southern Digital Commons](#):

"Textbook transformation journey: From traditional to no-cost materials", Beulah Narendrapurapu, Debanjana Ghosh, Arpita Saha, Leah Williams, Dawn Cannon-Rech, SoTL Commons Conference, Savannah, GA, February 2020.

We have also submitted an abstract for poster presentation at 2020 Biennial Conference on Chemical Education, another for Open Education Southern Symposium 2020. However, both the conferences were cancelled due to pandemic. We will look out for the future opportunities to present our post implementation data and findings. We are also interested in publishing our findings in scholarly journals.

7. Description of Photograph (optional)

This is where a team can list the names of the people shown in this separately uploaded photograph, along with their roles, if applicable.



Photo taken at SoTL Commons Conference 2020: From left to right: Debanjana Ghosh (co-PI), Beulah Narendrapurapu (PI), Arpita Saha (co-PI), Leah Williams (co-PI), Dawn Cannon-Rech (library liaison), Jeffrey Mortimore (LibGuides expert).

Acknowledgements: Our teams want to thank Jeffrey Mortimore for showing us how to upload content to LibGuides and edit them. His expertise is valuable maintaining LibGuides. We are grateful to Deborah Walker and Dawn Cannon-Rech for leading the OER Faculty Learning Commons workshops which led to the conception of this project. We also want to thank our colleague, Shainaz Landge for her encouragement. Finally, we are immensely grateful to University System of Georgia for supporting us through the Affordable Learning Georgia Textbook Transformation Grant.