Affordable Learning Georgia Textbook Transformation Grants

Final Report

To submit your Final Report, go to the Final Report submission page on the ALG website: http://affordablelearninggeorgia.org/site/final_report_submission

The final report submission form allows up to five files:

- This completed narrative document (required)
- Syllabus or syllabi (required)
  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: 05-17-21

Grant Round: 16

Grant Number: 506

Institution Name(s): Georgia Southern University

Project Lead: Priya Goeser

Team Members (Name, Title, Department, Institutions if different, and email address for each): Priya T. Goeser, Professor, Department of Mechanical Engineering, pgoeser@georgiasouthern.edu , Thomas Murphy, Associate Professor, Department of Computer and Electrical Engineering, tmurphy@georgiasouthern.edu , Christopher Williams, Lecturer, Department of Computer Science, christopherwilliams@georgiasouthern.edu , Jung Choi, Associate Professor, Department of Mechanical Engineering, jchoi@georgiasouthern.edu , and David Calamas, Associate Professor and Undergraduate Program Coordinator, Department of Mechanical Engineering, dcalamas@georgiasouthern.edu

Course Name(s) and Course Numbers: ENGR 1121 Computing Applications in Mechanical Engineering

Semester Project Began: Summer 2020

Final Semester of Implementation: Spring 2021

Total Number of Students Affected During Project: 124

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*

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

A free and online learning resource was provided for students in a freshmen mechanical engineering course, Computing Applications in Mechanical Engineering (ENGR 1121). This resource replaced the textbook for the MATLAB programing component of the course. The developed resource, MATLAB Marina, is a Virtual Learning Environment (VLE), and provides learning resources in multiple formats: written text, sample code, multimedia tutorials, and exercises for practice. The variety of formats is beneficial for students with diverse pedagogical needs and allows instructors to free up class time that might be used for lectures for additional problem solving and lab work.

A Microsoft Word template was developed for all the written portions of the VLE to ensure a consistent look, disability accessibility, and meet Affordable Learning Georgia (ALG) copyright requirements. The VLE primers and exercises were created/updated using this template and the created documents were tested for accessibility. The redesigned primers were developed to ensure a length corresponding to a short video (3 to 5 pages corresponding to 5 to 10-minute video). Existing primers were edited by at least one student worker and one team member. Many of the primers were split into several shorter documents and material rearranged to be more cohesive. New primers were developed for some topics such as algorithm development. Solutions to existing exercises were updated and made consistent and solutions to new exercises were developed and provided to the course instructors. Code samples for each module were updated and formatted consistently. The MATLAB Marina website was modified to support the new primer format and the new/updated primers and code samples incorporated.

On the website, links to the newly built primers were added to the appropriate topic pages and all updated primers and exercise files were uploaded to replace the previous versions. Additionally, code samples were updated to remove extraneous comment header information,

increase consistency across all code, as well as add a copyright notice pointing to the website for ease of maintenance. The “Team” page was updated to include student workers and additional faculty. The “Acknowledgements” page was updated to include new funding, and the “Relevant Publications” page was updated to include newer publications. Finally, the website and all associated files were moved into a Github repository to help track changes across multiple users as well as provide a central location for changes. Faculty members within the project are the only ones with access to the live server, which ensures that changes are checked before being posted.

As a part of continuous assessment, usage data for the website is tracked by Google Analytics and the multimedia tutorial usage is tracked by YouTube Analytics. This data is used not only for analysis of usage, but to help drive future changes to the overall organization and work of the team. For instance, it was noted that the longer PDF files were not being viewed as frequently or for very short durations, which helped drive the reformatting of the primers into the current structure.

A detailed list of topics covered in the course along with relevant links to modules on MATLAB Marina was created and shared with all faculty teaching the course in Spring 2021. A complete set of labs for each topic was also developed along with solutions to the problems in the labs. All these were shared via a folder on Google Drive with all faculty teaching the course. While 3 of the 4 instructors teaching the course in Spring 2021 actively used these, 1 did not to do so. Upon further discussion, the instructor said he considered the problems were ‘too complicated’ for students in his class. In future semesters such issues will be addressed earlier in the semester. In traditional semesters, there is at least one day a month when all faculty in the Department of Mechanical Engineering (across both campuses) meet for departmental meetings as well as course level meetings. These are usually in-person meetings. However, since Spring 2020 these meetings have been held remotely and were often not well attended and the many faculty did not participate actively. In subsequent semesters the in-person course level meetings will have a required component that will discuss the implementation of this VLE in ENGR 1121.

The original MATLAB Marina site is hosted on a Georgia Southern University server and has a domain name: http://www.matlabmarina.com. There were at least 2 occasions when the server was rebooted which caused the site to not be accessible. Since then, this issue has been resolved and the site was uninterrupted on future server reboots. However, in order to address any such issue in the future, a simpler version of the VLE was created as a Google Site and is hosted by the project lead Dr. Priya Goeser. This backup site: https://sites.google.com/georgiasouthern.edu/matlabmarina/home mirrors all the modules and content on the original site and will be made available only if the original site is not accessible.

Overall, the use of the resource in ENGR 1121 was beneficial for faculty and students. Students had access to multiple examples some of which were explained using a step-by-step video tutorial, while others were explained within the primers and others were included as a supplement to the primers. When examples are made available in multiple formats, students are willing to take the initiative to learn and master the concepts rather than simply rely on the support from the instructor and tutors or friends/peers. For instance, there are certain concepts such as 'using a for loop for a running sum' which are challenging for most students and in the past instructors have had to explain this concept multiple times using multiple formats or sometimes even have to repeat these explanations. Now, instructors can introduce the concept and point the students to the other examples, which students can watch/read at their own pace and multiple times if needed. Hence, instructors were able to spend more in-class time helping students understand the application of concepts and debug their programs.

The biggest challenge was finding time in Spring 2020 and Fall 2020 to work on the project and coordinating decisions without in-person meetings. The university went to fully remote instruction and operation shortly after the Spring 2020 kickoff meeting and the team members had very little time to work on the project until the summer. Prior to March 2020, the team members on the Armstrong campus would fairly regularly meet in-person as office proximity made this easy. Summer work between team members and student workers was coordinated using email and video meetings rather than in-person meetings. With instruction remaining at least partly remote/online and some classes sub-sectioned in Fall 2020, it was again difficult finding time to devote to the project and prepare for its use in Spring 2021.

While updating and developing new exercises and examples for the primers, it was recognized that having one of the mechanical engineering team members more involved in this part of the project would have been beneficial. The two student workers and the primary team member working on the primers and exercises had computer science, computer engineering, and electrical engineering backgrounds. Ideas for examples and exercises had to be solicited from the mechanical engineering team members and mechanical engineering students. Both the primers and exercises could benefit from additional discipline specific examples and problems.

Most of the problems encountered were due to the instruction circumstances this past year and not things that could be learned from and done differently in the future. One benefit of this though is the increased ability and willingness of university faculty and staff to conduct business/meetings remotely.

An unplanned advantage of this VLE was that students who had to be out of class for 10-14 days because of sickness or quarantine requirements were able to access the resource and use it independently and learn the material well.

The Microsoft Word template developed is also being used to format materials for other courses. The knowledge and experience gained from enhancing and modifying the primers is being used to overhaul other course materials provided to students.

2. Quotes

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

Student A:

“Matlab marina was quite helpful in the days of 1121, though its usefulness waned as I became more competent in coding and I find myself only occasionally referencing it now. It is very helpful for getting a baseline understanding of concepts and learning fundamentals. One advantage matlab marina has over matlabs built in documentation is the length of its examples. Matlab marina gives students actual programs to look at and allows them to see the techniques in documentation applied to an actual program.”

Student B:

"Matlab marina did a good job of breaking down the concepts and helping me learn Matlab. It served as a good supplement to the material I learned in my Matlab Class."

Student C:

“As a student that hates to buy textbooks, MM is great since it is free and accessible wherever there is internet. This is especially useful since students who access their labs online can also access MM and use it as a reference, while switching back and forth with ease, to ensure correct style and syntax.”

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: 124

- Positive: 36.67 % of 30 number of respondents

- Neutral: 63.33 % of 30 number of respondents
- Negative: 26.67 % of 30 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:

- 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?

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.

17.74 % of students, out of a total 124 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)

B. Measures 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.

[When submitting your final report, as noted above, you will also need to provide the separate file (or .zip with multiple files) of supporting data on the impact of your Textbook Transformation, such as surveys, analyzed data collected, etc.]

- *Include measures such as:*
  - *Drop, fail, withdraw (DFW) delta rates*
  - *Course retention and completion rates*
  - *Average GPA*
  - *Pre-and post-transformation DFW comparison*
  - *Student success in learning objectives*
  - *Surveys, interviews, and other qualitative measures*
- *Indicate any co-factors that might have influenced the outcomes.*

The first semester of implementation, where the VLE was used across all sections of ENGR 1121, students were given a pretest near the beginning of the semester and a posttest near the end of the semester. The tests consisted of the same questions presented in the same order. The average score for the pretest was 52.6% while the average score of the posttest was 75.0%. Therefore, during the final semester of the project an increase in student performance was recorded.

In Spring 2021, 22 of 124 (17.74%) students dropped, withdrew, or failed the course. During the previous semester, 15 of 58 (25.86%) of students dropped, withdrew, or failed the course. Therefore, during the final semester of the project, a reduction in the D/W/F rate was achieved.

Surveys were given to students to complete anonymously to determine their attitudes and perceptions of using a traditional textbook versus the VLE as their main instructional resource. Other than the anticipated low to no cost perspectives, a couple of other advantages noted by students were: easily searchable material and no added weight that they would need to carry around every day.

At the end of the final semester of the project students were asked if they preferred a VLE like MATLAB Marina or a traditional textbook. 36.67% of respondents preferred a VLE, 26.67% preferred a traditional textbook, and 63.37% either had no preference or were unsure.

The project team does think that the change to online/hybrid learning since Spring 2020 - Spring 2021 has some impact on the assessment mentioned above. Continuous assessment over subsequent semesters will be compiled to further assess this impact. In addition, the

overall enrollment in this course was lower than usual (124 compared to 175 during the spring semester) due to the COVID-19 pandemic. In a normal setting, the transformative impact of this project will impact about 270 students per academic year.

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.

Currently 4-5 sections of ENGR 1121 are offered every fall and 5-7 sections every spring semester. This is a required course in the Bachelor of Science in Mechanical Engineering curriculum at Georgia Southern. Three of the project team members are the instructors of record for the course and one serves as the course coordinator. This ensured that the VLE was used as the primary resource for MATLAB in all sections of ENGR 1121 in Spring 2021 and will be used as the primary resource in subsequent semesters. At the beginning of each semester a workshop will be held for all instructors of record. The workshop will introduce the VLE to any new instructors. It will also serve as a debrief/brainstorm retrospective session for instructors from the most recent semester to address the effectiveness of the VLE and teaching pedagogy. Notes from these discussions will be compiled and added to the "teaching guide" used as a reference by instructors during the semester.

This process of "Start, Stop and Continue" is an effective way for the team to fine tune best practices by reflecting on recent implementations and decide on any changes for the next round. These workshops will be held every semester for 3-5 years from Fall 2021 with the intent to develop uniformity and consistency in the use of the VLE across all sections of the course. Continuous assessment of the course: student performance and retention, and assessment of the VLE will be done every semester. It is noted here that course assessment will be completed every semester by the Undergraduate Program Coordinator who is also a team member and will be compiling similar data for ABET reports. The assessment will be used as valuable feedback for updates to the VLE. The project lead and course coordinator will continue to oversee these updates as well as any updates that need to be done to reflect software version updates.

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.

This project allowed MATLAB Marina to be expanded and enhanced and replace the textbook used for the MATLAB portion of an introductory programming course for mechanical engineers. The enhanced and expanded VLE was tailored to the specific course learning outcomes while

still being relevant as a general MATLAB/programming resource for use in similar courses and as a long-term reference in follow up courses.

Affordable, especially free, course materials are appreciated by students. Students are generally relieved when they do not have to purchase an expensive textbook that might only be used for one course. The team members involved with this project had already been providing free learning resources to their students in a variety of courses. Through work on this endeavor and teaching at least partly online/remotely over the last year; team members have been spurred to create additional learning resources to supplement or replace lost in person class time. These free resources include written notes, written help documents, lecture style videos, and video tutorials. Some were developed in advance and others developed just in time as student's learning needs changed. The team members were comfortable creating these materials in part due to work on this project.

The course under consideration, ENGR 1121, also covers content using Microsoft Excel using a traditional textbook. A proposal for replacing this textbook with Open Educational Resources is a short-term goal of the team. Longer-term goals are to add to MATLAB Marina so that it could be used as the primary resource in introductory programming courses for other departments (civil engineering, CENG 1731, and electrical and computer engineering, ENGR 1731) and to add materials to support engineering courses with programming components. The VLE is currently used as a supplementary resource in one section of ENGR 1731 at the Armstrong Campus. It is also used by students in other disciplines as a resource when they become aware of it even though it is not the primary textbook/resource.

Since the student surveys show that there are still a handful of students who prefer printed materials, it may be worthwhile to offer a more textbook like version of the primers/exercises to them. This would be offered as a downloadable e-book; which students could print at their own cost.

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

This work was presented and published at the American Society for Engineering Education Southeast Section's 2021 Virtual Conference in March 2021: Murphy, T., Williams, C. and Goeser, P.T., "Re-Designing the Primers on MATLAB Marina." *The ASEE SE Section Annual Conference.* Virtual. March 8th – March 11th, 2021.

An extension of this paper will be submitted for publication in the Journal of Higher Education Theory and Practice Summer 2021 issue.

A summary of the assessment and implementation of the VLE will be presented and published at the American Society for Engineering Education Annual Conference and Exposition. This will also result in a pedagogical peer reviewed publication in the conference proceedings: Goeser, P.T., Murphy, T., Williams, C., Choi, J. and Calamas, D. "MATLAB Marina: The Primary Resource for MATLAB in a Freshmen Computing Applications for Mechanical Engineers Course." *The ASEE Annual Conference and Exposition.* Virtual. July 26th –July 29th, 2021.

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.

Dr. Priya Goeser is a Professor in the Department of Mechanical Engineering. She coordinated the overall project, the design of the VLE and the development of tutorials. She is also the instructor of record for ENGR 1121 on the Armstrong Campus.

Dr. Thomas Murphy is an Associate Professor in the Department of Electrical and Computer Engineering. He is the primary developer of the primers and exercises on MATLAB Marina.

Mr. Christopher Williams is a Lecturer in the Department of Computer Science. He designed and developed the website for MATLAB Marina. Mr. Williams will continue to maintain the website and oversee assessment including website usage and tracking.

Dr. Jung Choi is an Associate Professor in the Department of Mechanical Engineering and is the course coordinator and an instructor of record for ENGR 1121 on the Statesboro Campus. He will ensure that all sections of the course will use the VLE in lieu of the textbook beginning Spring 2021 and following semesters.

Dr. David Calamas is the Undergraduate Program Coordinator and an Associate Professor in the Department of Mechanical Engineering. He is an instructor of record for ENGR 1121 on the Statesboro Campus. He will oversee the assessment and continuous improvement of the VLE after implementation.