Table of Contents

Application Summary

Competition Details

Competition Title:	Textbook Transformation Grants, Round Sixteen (Spring 2020 - Spring 2021)
Category:	University System of Georgia
Award Cycle:	Round 16
Submission Deadline:	01/13/2020 at 11:59 PM

Application Information

Submitted By:	Priya Goeser
Appplication ID:	3969
Application Title:	506
Date Submitted:	01/14/2020 at 8:13 AM

Personal Details

Institution Name(s):	Georgia Southern University
Applicant First Name:	Priya
Applicant Last Name:	Goeser
Applicant Email Address:	pgoeser@georgiasouthern.edu
Applicant Phone Number:	9123442874
Primary Appointment Title:	Professor
Submitter First Name:	Priya
Submitter Last Name:	Goeser
Submitter Email Address:	pgoeser@georgiasouthern.edu
Submitter Phone Number:	9123442874
Submitter Title:	Professor

Application Details

Proposal Title
506

Requested Amount of Funding
$29,922

Priority Category (if applicable)
None / N/A

Final Semester:
Spring 2021

Course Title(s)
Computing Applications in Mechanical Engineering

Course Number(s)
ENGR 1121

Team Member 1 Name
Priya Goeser

Team Member 1 Email
pgoeser@georgiasouthern.edu

Team Member 2 Name
Thomas Murphy

Team Member 2 Email
tmurphy@georgiasouthern.edu

Team Member 3 Name
Christopher Williams

Team Member 3 Email
christopherwilliams@georgiasouthern.edu

Team Member 4 Name
Jung Choi

Team Member 4 Email
jchoi@georgiasouthern,edu

Additional Team Members (Name and email address for each)
David Calamas

dcalamas@georgiasouthern.edu

Sponsor Name
Dr. Brian L. Vlcek

Sponsor Title
Department Chair and Professor

Sponsor Department
Department of Mechanical Engineering

Total Number of Student Section Enrollments Affected by Project in One Academic Year
270

Average Number of Student Section Enrollments Affected per Summer Semester

0

Average Number of Student Section Enrollments Affected per Fall Semester
95

Average Number of Student Section Enrollments Affected per Spring Semester
175

Original Required Commercial Materials (title, author, price, and bookstore or retailer URL showing price)
MATLAB for Engineering Applications, 4th Edition
By William Palm III
Bookstore price: $82
https://gsustore.com/CourseMaterials?Ids=2965742
Publisher price: $97.33 (Loose-Leaf purchase)
https://www.mheducation.com/highered/product/matlab-engineering-applications-palm-iii/M9781259405389.html

Spreadsheet Tools for Engineers Using Excel, 4th Edition
By Byron Gottfried
Bookstore price: $97.33
https://gsustore.com/CourseMaterials?Ids=2965742
Publisher price: $81.95
https://www.mheducation.com.sg/ise-spreadsheet-tools-for-engineers-using-excel-9781260085075-asia

Original Total Cost per Student
$179

Post-Project Cost per Student
$0

Post-Project Savings per Student
Average savings per student: $82 - $97.33 (a reduction of about 50% of the previous cost) The Microsoft Excel Textbook (Spreadsheet Tools for Engineers Using Excel, 4th Edition by Byron Gottfried) will still be required.

Projected Total Annual Student Savings per Academic Year
$22,140-$26,279

Using OpenStax Textbook?
No

Project Goals
The primary objective of this project is to transform a freshmen mechanical engineering course, Computing Applications in Mechanical Engineering by providing students with a better learning experience as well as access to learning resources (textbook material) without any cost. Currently this course covers computing applications in Excel, MATLAB and Mathcad with textbooks for Excel and MATLAB and instructor notes for Mathcad. The instructor notes for Mathcad are available to students at no cost, however students are required to purchase the two other textbooks. **This project aims to replace the textbook currently used for MATLAB with resources that will be available online in a Virtual Learning Environment (VLE) at no cost to students.** Resources will be available in multiple formats including written text, sample codes, multimedia tutorials, exercises for practice and self-assessment tools. The multiple formats will address the needs of a student body with diverse pedagogical needs.

Statement of Transformation

Georgia Southern University is the state's largest and most comprehensive center of higher education south of Atlanta and is spread across three campuses (Statesboro, Armstrong and Liberty). The Department of Mechanical Engineering is the largest department in the Allen E. Paulson College of Engineering and Computing and is represented on two campuses. The Statesboro Campus hosts the department offices and offers the complete 4-year BSME degree program with an average enrollment of over 1,000 students and the Armstrong Campus in Savannah offers the first 3 years of the mechanical engineering curriculum and has an average enrollment of 60 students. Computing Applications in Mechanical Engineering (ENGR 1121) is a required course for all mechanical engineering students at Georgia Southern University. Several sections of the course are offered in both fall (4-5 sections) and spring (5-7 sections) semesters. As the enrollment in the department continues to grow, there is the potential to offer a section of the course in the summer semester. Currently one section of the course is offered every spring semester on the Armstrong Campus. There is complete uniformity in the curriculum across all campuses: same content, textbooks, as well as course objectives and student outcomes. This transformation will be implemented for all sections of the course department wide and across both campuses. The course (ENGR 1121) is a 2-credit hour course taught as a laboratory only course with no separate lecture component and meets for 100 minutes twice a week in a computer lab. The pre-requisites/co-requisites for the course are College Trigonometry, Pre-calculus and/or Calculus I. The course serves as a first course in computer programming for mechanical engineering students. Hence, students are challenged by the course. While the lab sessions allow for hands-on work, there is little time for in-class lecture from the instructor. The VLE will be designed to improve student performance by providing reinforcing learning materials.

This VLE will be an enhanced and expanded version of MATLAB Marina1 – a VLE originally created by the project lead with two of the team members to replace the textbook in the course Computing for Engineers. This original work was successful and received the Affordable Learning Georgia Recognition Award for Innovation and Early Success in Textbook Transformation in 2014. The impact of this work was significant not only in terms of cost savings for the students but also in improving student performance and retention (Fall 2013-Spring 2018)2,3. Student feedback over these semesters consistently showed that students appreciated the cost savings as well as the online resource instead of a traditional textbook for learning MATLAB. However, after the recent consolidation of Georgia Southern University and Armstrong State University the VLE is no longer used as such due to curricular changes. The course prior to consolidation was also based solely on MATLAB and targeted a different student body – students in all engineering disciplines, most of whom were intending to transfer to the Georgia Institute of Technology, whereas ENGR 1121 is taken exclusively by Georgia Southern Mechanical Engineering students. Based on the success of MATLAB Marina and the availability of this curated content, these three team members are now partnering with two faculty members from the Department of Mechanical Engineering on the Statesboro Campus to expand and use this VLE for all sections of ENGR 1121.

The transformative impact of this project will be reflected in the following aspects:

- On an average, 270 students take this course every academic year which will result in a projected savings of $22,140-$26,279 per year. This is a 50% cost savings for each student taking this course.
- The course material on the VLE can be tailored and better aligned with the course and learning outcomes specific to this course.
- The material provided on the VLE will be in a format that is more interactive with students, including multimedia videos, web-based text with clickable links to sample codes and self-assessment tools. Many students do not read significant portions of printed text, so these formats will provide them with a better tailored learning experience.
- The VLE can also be used as supplement in other courses offered within the department such as MENG2139 – Numerical Methods for Engineers and outside the department such as the ENGR 1731 – Computing for Engineers, ENGR 2341 – Introduction to Signal Processing, all of which use MATLAB.
- The VLE can be used as a reference by students in upper level engineering courses when they need to use MATLAB for projects.
- The VLE can be updated relatively easily as versions in MATLAB change or as new topics are introduced in the course.
- The online resource provides a broader impact as the VLE will be available for anyone and at anytime.

References (for this section):

1. www.matlabmarina.com
2. Murphy, T., Goeser, P.T. and Williams, C., "Analysis of Usage Statistics of MATLAB Marina – A Virtual

Learning Environment." The ASEE SE Section Annual Conference. Daytona Beach, March 4th – March 6th 2018.
3. Goeser, P.T., Murphy, T., Williams, C. and Johnson, W., "The Effective Use of Virtual Learning Environments like MATLAB Marina as the Primary Resource for an Introductory Programming Course." The ASEE SE Section Annual Conference. Macon, Georgia, March 30th –April 1st 2014.

Transformation Action Plan

An evaluation of currently existing OER shows that there is not a wealth of free online resources for MATLAB as there is for other high-level programming languages such as C/C++ and Java for introductory programming courses. There is an Introduction to MATLAB course1 in MITOPENCOURSEWARE most recently offered in Fall 2011. MathWorks (the company that developed MATLAB)2 publishes a MATLAB Primer for each MATLAB release and has video tutorials but this is a collection of function documentation or how to use features and not introductory instructional resources. There are also YouTube videos that have MATLAB tutorials but mostly geared towards doing specific applications using MATLAB than introductory instructional resources.

The goal of this project is to build from an existing VLE that will replace a textbook in the course ENGR 1121 and can be easily maintained. The primary content covered by the material will be programming using MATLAB. All team members are subject matter experts and have taught or are currently teaching freshmen programming courses based on MATLAB.

An overview of each team member's roles and their primary responsibility is listed below:

- The project lead Dr. Priya Goeser pioneered MATLAB Marina which is still being used extensively and globally (189,328 pageviews, 21,540 users from August 1st, 2013 to December 17th 2019, tracked by Google Analytics). She is also the instructor of record for ENGR 1121 on the Armstrong Campus. Dr. Goeser is a Professor in the Department of Mechanical Engineering and is currently the President-Elect of the American Society for Engineering Education (ASEE) Southeast Section, and she is very active in the scholarship of engineering education. She will coordinate the overall project, the design of the VLE and the development of new/updated tutorials.
- Dr. Thomas Murphy is an Associate Professor in the Department of Electrical and Computer Engineering. He developed all the primers and exercises on MATLAB Marina and is the instructor of record for the course Computing for Engineers (ENGR 1731) on the Armstrong Campus. This course is based solely on MATLAB. Dr. Murphy will work on the development of new/updated materials for the primers and exercises which serve as the text in the individual chapters/modules. Dr. Murphy has completed the Georgia Southern Teaching Online Courses (TOC) Workshop and the TOC Design Practicum and has online teaching and course development status for Georgia Southern.
- Mr. Chris Williams is a Lecturer in the Department of Computer Science on the Armstrong Campus and has experience with website and instructional design. He designed and developed the website for MATLAB Marina. Mr. Williams has experience teaching numerous programming courses in engineering, computer science and information technology and continues to be active in the scholarship of programming education. He will serve as the instructional designer for the team and focus on redesigning the overall website including all the modules housed on the VLE. Mr. Williams will also lead the efforts in developing self-assessment tools for students to use in every module.
- Dr. Jung Choi is an Assistant 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 oversee the identification of key modules that need to be developed and/or updated for the course and ensure that the modules follow the course and learning outcomes. Dr. Choi will also ensure that all sections of the course will use the VLE in lieu of the textbook beginning Spring 2021 and following semesters. He will organize a workshop every semester to provide training for all new instructors teaching the course, so they are well versed with the VLE and the teaching pedagogy needed for its successful implementation.
- Dr. David Calamas is the Undergraduate Program Coordinator and an Associate Professor in the Department of Mechanical Engineering. He is also the Technical Program Chair of the ASEE Southeast Section and has been active in engineering education. He is an instructor of record for ENGR 1121 on the Statesboro Campus and was actively involved in the creation of the course in 2015. Dr. Calamas is the Chair of the Assessment Committee in the Department of Mechanical Engineering and oversees program-level external accreditation by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). He will oversee the assessment and continuous improvement of the VLE after implementation.

The first 3 team members listed above are based on Georgia Southern's Armstrong Campus, and have worked

together for 15 years and have collaborated on several scholarly and service activities. They also have coauthored pedagogical papers based on their work on MATLAB Marina. They have known Dr. Calamas for about 5 years from their involvement in the ASEE. Dr. Goeser and Dr. Calamas have worked with Dr. Choi on multiple department level committees over the past three years. Overall the project team is inter-disciplinary and multi-campus and are equipped to work together in a coordinated team effort to make this transformation successful.

The transformation process will involve the following phases:

- Phase I: Designing the VLE Identify modules that serve as book chapters/topics on MATLAB Marina that correspond to the topics covered in the courseRe-design the website to be more conducive to this courseRe-design the modules to be more interactive and provide students with a beneficial learning experience
- Phase II: Development of the VLE Develop new modules and update existing ones to better align with the current course outcomesDevelop new and update existing multimedia tutorials for the modulesConvert the current primers (static texts posted as pdf documents) into interactive text on the modulesCreate a bundled format of current primers and post it on the website as an optional downloadable e-bookDevelop new and update the exercises for the modulesEnsure that all material is fully accessible
- Phase III: Implementation of the VLE in the course Organize a workshop to introduce the VLE to all instructors of record for all sections. Also discuss the teaching pedagogy that will be used for its implementation.Develop the student surveys and that will be used for assessmentCollect and evaluate comparative student performance data that can be used for continuous improvement and sustainability.

The VLE will be hosted on a Georgia Southern web server that is publicly accessible through the matlabmarina.com domain name. All course materials will be web-based and available to anyone with internet access. Self-assessment and practice exercises will be available through an open-access software application developed by the project team. This application will be distributed to faculty at other institutions upon request. After evaluating existing alternatives including the one developed by MathWorks, MATLAB Cody3, which works well for self-assessment, the project team determined that having the ability to tailor an assessment application for the specific needs of students in ENGR 1121 would be more beneficial for this transformation.

References (for this section):

1. https://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab-programming-fall-2011/
2. https://www.mathworks.com/
3. https://www.mathworks.com/matlabcentral/cody/

Quantitative & Qualitative Measures

Quantitative Measures:

A pre-test and post-test will be given to students before and after taking the course to asses students' knowledge of MATLAB prior to and after taking the course. Student performance in the course will be measured by compiling aggregate grade distribution in all sections for in-class lab assignments, exams and projects (based on material in the VLE). This will be compared with the data from 2018-2020 (the semesters prior to implementation of the VLE). In addition, students also score the course textbook material as part of the end of the semester course evaluation implemented by the University. Data from this report will be compared with those in the prior semesters. Retention will be measured by comparing the fail/withdrawal rates (Georgia Southern does not have a drop rate) with those in the past semesters. Analytic data from the MATLAB Marina website (tracked by Google Analytics) and from the multimedia tutorials (posted as YouTube videos tracked by YouTube Analytics) will be examined to determine student usage of the VLE resources and materials. Data available through the analytics sources will be used to determine any trends or issues that might influence student usage and performance. Google and YouTube Analytics can also be used to assess if the usage is limited to certain geographic regions or if the use of the VLE is more global.

Qualitative Measures:

Surveys will be given to students to complete anonymously to determine their attitudes and perceptions of the class using a traditional textbook versus the VLE as their main instructional resource. These surveys will include inquiries about study time, specific resource usage, and preferences regarding textbooks versus VLE usage in this specific class. The surveys will be given at least two times a semester (when MATLAB is first introduced in the course and at the end of the MATLAB portion of the course). The surveys will intentionally include a combination of answering questions using a Likert scale and written comments to better assess the data obtained.

Timeline

February 2020:

- Two team members attend the Kick off Meeting
- Complete a student survey in the Spring 2020 sections of ENGR 1121 to get student suggestions on a 'user friendly' VLE
- Recruit student assistants for project.

March – April 2020:

- Compile student performance data from past semesters for quantitative assessment
- Complete Phase I: Designing the VLE

May - July 2020:

- Begin working on Phase II: Development of the VLE Develop new modules and update existing onesDevelop new and update existing multimedia tutorialsConvert the current primers into interactive text on the modules

August 2020:

- Refine the teaching pedagogy for the VLE
- Meet and discuss the progress of the VLE and teaching pedagogy with all instructors of record for all sections of the course. Compile all feedback received from this discussion.

September – November 2020:

- Complete Phase II: Development of the VLE Create the downloadable e-bookDevelop new and update the exercises for the modulesRefine modules and teaching pedagogy based on feedback received

December 2020:

- Organize a 1-hour workshop for all instructors scheduled to teach ENGR 1121 in Spring 2021
- Develop a short 15-20 minutes webinar based on this workshop to use in subsequent semesters for any new faculty teaching the course for the first time

January – April 2021:

- Complete Phase III: Implementation of the VLE Conduct pre/post-tests to asses student's knowledge of MATLABCompile all qualitative and quantitative data for assessment
- Maintain a live working document (google doc) that has a log of questions, suggestions, comments, etc. from all instructors teaching the course in Spring 2021. This document will serve as a 'teaching guide' that instructors can refer to in future semesters.
- Present and publish work in the following peer-reviewed conference: the American Society for Engineering Education Southeast Section Conference.

May 2021:

- Organize a 1-hour workshop for any new instructors scheduled to teach ENGR 1121 in Fall 2021. This workshop will also be used as debrief/brainstorm retrospective session to discuss the effectiveness of the VLE and teaching pedagogies with all instructors from Spring 2021.
- Analyze the VLE based on all the assessment data collected
- Complete a final report including suggestions for future semesters
- Contact faculty who teach similar courses at other USG institutions and share assessment data and teaching pedagogies.

June 2021:

- Present work 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.

Budget

Summer salary for Dr. Priya Goeser - $5000

Summer salary for Dr. Thomas Murphy - $5000

Summer salary for Mr. Chris Williams - $5000

Summer salary for Dr. Jung Choi - $4000

Summer salary for Dr. David Calamas - $4000

Student research assistants $3000 (3 students; $10 per hour; 10 hours a week; for 10 weeks)

Camtasia 2019 (software): $507 ($169 x 3 licenses)

Website domain name renewal (9 years maximum) $115

Travel for kick off meeting: $800

Travel for at least one team member to present the work at two flagship conferences in engineering education:

- American Society for Engineering Education Southeast Section Conference in Fairfax, Virginia in March 2021: $500
- American Society for Engineering Education Annual Conference and Exposition in Long Beach, California in June 2021: $2000

Total cost $29,922

Sustainability Plan

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 BSME 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 ensures that the VLE will be used as the primary resource for MATLAB in all sections of ENGR 1121 in Spring 2021 and subsequent semesters. At the end 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 starting from Spring 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. At least one team member will travel to disseminate this work at the ASEE Southeast Section Conference in March 2021 and one to the ASEE Annual Conference and Exposition in June 2021. This work will also be published in the scholarship of engineering education. All significant assessment results and effective teaching pedagogies will be shared with the faculty at other institutions (USG and beyond) at the above-mentioned conferences to encourage them to use the VLE in their programming courses.

The VLE will also be used as a supplemental resource in one section of ENGR 1731 at the Armstrong Campus, taught by one of the team members. A future proposal for a strategic transformation between multiple courses such as ENGR 1121 and ENGR 1731 across multiple departments is a long-term goal and part of the sustainability plan for this project.

Acknowledgment

Grant Acceptance

[Acknowledged] I understand and acknowledge that acceptance of Affordable Learning Georgia grant funding constitutes a commitment to comply with the required activities listed in the RFP and that my submitted proposal will serve as the statement of work that must be completed by my project team. I further understand and acknowledge that failure to complete the deliverables in the statement of work may result in termination of the agreement and funding.

GEORGIA SOUTHERN UNIVERSITY

19 December 2019

To: Textbook Transformation Grants Reviewers

Subject: Letter of Support for a Large-Scale Transformation Grant

Dr. Priya Goeser, Dr. Thomas Murphy, Mr. Chris Williams, Dr. Jung Choi and Dr. David Calamas are working collaboratively to develop an online resource that will replace a current textbook used in the instruction of the programming language MATLAB in the course Computing Applications for Mechanical Engineering (ENGR1121). This course is a required course in the BSME curriculum, and it is currently taught both the Fall and Spring semesters in multiple sections. The course is also offered on both Georgia Southern's Statesboro and Armstrong campuses in the Spring. The textbook replacement will be implemented for all sections of the course, on both campuses beginning Spring 2021 and continuing subsequent semesters. Similarly, all supplemental instructional materials will be implemented into all sections of the course beginning Spring 2021. This transformation will impact approximately 270 students per academic year.

Since the course is required for all mechanical engineering students at Georgia Southern, this transformation will be sustainable over the long term. It will also improve the retention, progression and graduation of students in the program.

The project also has broader impacts. Both Dr. Goeser and Dr. Calamas are active in the scholarship of engineering education and hold leadership positions in the American Society for Engineering Education's Southeast Section. Overall, the project team is well equipped and suited to bring this transformation to a successful completion. The Department of Mechanical Engineering strongly supports their efforts to improve the educational experience while reducing costs to our students.

I will be closely engaged with this endeavor, and look forward to the positive impacts the transformation will have on our BSME degree. Please feel free to contact me with any questions.

Sincerely,

Brian L Vlcek

Dr. Brian L. Vlcek
Professor and Department Chair,
Department of Mechanical Engineering,
Allen E. Paulson College of Engineering and Computing
Georgia Southern University

Textbook Transformation Grants, Round Sixteen (Spring 2020 – Spring 2021)

Proposal Form and Narrative

Replace the textbook for MATLAB used in the course
ENGR 1121 Computing Applications in Mechanical Engineering
with a no cost online, Virtual Learning Environment

Applicant, Team, and Sponsor Information

Institution(s)	Georgia Southern University
Applicant Name	Priya T. Goeser
Applicant Email	pgoeser@georgiasouthern.edu
Applicant Phone #	912 344 2874
Applicant Position/Title	Professor, Department of Mechanical Engineering
Submitter Name	
Submitter Email	
Submitter Phone #	
Submitter Position	

Please provide the first/last names and email addresses of all team members within the proposed project. Include the applicant (Project Lead) in this list. Do not include prefixes or suffixes such as Ms., Dr., Ph.D., etc.

	Name	Email Address
Team Member 1	Priya T. Goeser (Project Lead)	pgoeser@georgiasouthern.edu
Team Member 2	Thomas Murphy	tmurphy@georgiasouthern.edu
Team Member 3	Christopher Williams	christopherwilliams@georgiasouthern.edu
Team Member 4	Jung Choi	jchoi@georgiasouthern.edu
Team Member 5	David Calamas	dcalamas@georgiasouthern.edu

Team Member 6		
Team Member 7		
Team Member 8		

If you have any more team members to add, please enter their names and email addresses in the text box below.

N/A

Please provide the sponsor's name, title, department, and institution. The sponsor is the provider of your Letter of Support.

Dr. Brian L. Vlcek, Department Chair and Professor, Department of Mechanical Engineering, Allen E. Paulson College of Engineering and Computing, Georgia Southern University

Project Information and Impact Data

Priority Category / Categories	None
Requested Amount of Funding	$29,922
Course Names and Course Numbers	ENGR 1121 Computing Applications in Mechanical Engineering
Final Semester of Project	Spring 2021
Total Number of Student Section Enrollments Affected by Project in One Academic	270 students (9-12 sections offered on two campuses)

Year	
Average Number of Student Section Enrollments Affected per Summer Semester	0
Average Number of Student Section Enrollments Affected per Fall Semester	95 (4-5 sections)
Average Number of Student Section Enrollments Affected per Spring Semester	175 (5-7 sections)
Original Required Commercial Materials	MATLAB for Engineering Applications, 4th Edition By William Palm III Bookstore price: $82 https://gsustore.com/CourseMaterials?Ids=2965742 Publisher price: $97.33 (Loose-Leaf purchase) https://www.mheducation.com/highered/product/matlab-engineering-applications-palm-iii/M9781259405389.html Spreadsheet Tools for Engineers Using Excel, 4th Edition By Byron Gottfried Bookstore price: $97.33 https://gsustore.com/CourseMaterials?Ids=2965742 Publisher price: $81.95 https://www.mheducation.com.sg/ise-spreadsheet-tools-for-engineers-using-excel-9781260085075-asia
Average Price of Original Required Materials Per Student Section Enrollment	Cost per student: $179
Average Post-Project Cost Per Student Section Enrollment	$0
Average Post-Project Savings Per Student Section Enrollment	Average savings per student: $82 - $97.33 (a reduction of about 50% of the previous cost) The Microsoft Excel Textbook (Spreadsheet Tools for

	Engineers Using Excel, 4th Edition by Byron Gottfried) will still be required.
Projected Total Annual Student Savings Per Academic Year	$22,140-$26,279
Using OpenStax Textbook?	No

Narrative Section

1. Project Goals

The primary objective of this project is to transform a freshmen mechanical engineering course, Computing Applications in Mechanical Engineering by providing students with a better learning experience as well as access to learning resources (textbook material) without any cost. Currently this course covers computing applications in Excel, MATLAB and Mathcad with textbooks for Excel and MATLAB and instructor notes for Mathcad. The instructor notes for Mathcad are available to students at no cost, however students are required to purchase the two other textbooks. **This project aims to replace the textbook currently used for MATLAB with resources that will be available online in a Virtual Learning Environment (VLE) at no cost to students.** Resources will be available in multiple formats including written text, sample codes, multimedia tutorials, exercises for practice and self-assessment tools. The multiple formats will address the needs of a student body with diverse pedagogical needs.

2. Statement of Transformation

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required course for all mechanical engineering students at Georgia Southern University. Several sections of the course are offered in both fall (4-5 sections) and spring (5-7 sections) semesters. As the enrollment in the department continues to grow, there is the potential to offer a section of the course in the summer semester. Currently one section of the course is offered every spring semester on the Armstrong Campus. There is complete uniformity in the curriculum across all campuses: same content, textbooks, as well as course objectives and student outcomes. This transformation will be implemented for all sections of the course department wide and across both campuses. The course (ENGR 1121) is a 2-credit hour course taught as a laboratory only course with no separate lecture component and meets for 100 minutes twice a week in a computer lab. The pre-requisites/co-requisites for the course are College Trigonometry, Pre-calculus and/or Calculus I. The course serves as a first course in computer programming for mechanical engineering students. Hence, students are challenged by the course. While the lab sessions allow for hands-on work, there is little time for in-class lecture from the instructor. The VLE will be designed to improve student performance by providing reinforcing learning materials.

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References (for this section):

1. www.matlabmarina.com
2. Murphy, T., Goeser, P.T. and Williams, C., "Analysis of Usage Statistics of MATLAB Marina – A Virtual Learning Environment." *The ASEE SE Section Annual Conference*. Daytona Beach, March 4th – March 6th 2018.
3. Goeser, P.T., Murphy, T., Williams, C. and Johnson, W., "The Effective Use of Virtual Learning Environments like MATLAB Marina as the Primary Resource for an Introductory Programming Course." *The ASEE SE Section Annual Conference*. Macon, Georgia, March 30th –April 1st 2014.

3. Transformation Action Plan

An evaluation of currently existing OER shows that there is not a wealth of free online resources for MATLAB as there is for other high-level programming languages such as C/C++ and Java for introductory programming courses. There is an Introduction to MATLAB course[1] in MITOPENCOURSEWARE most recently offered in Fall 2011. MathWorks (the company that developed MATLAB)[2] publishes a MATLAB Primer for each MATLAB release and has video tutorials but this is a collection of function documentation or how to use features and not introductory instructional resources. There are also YouTube videos that have MATLAB tutorials but mostly geared towards doing specific applications using MATLAB than introductory instructional resources.

The goal of this project is to build from an existing VLE that will replace a textbook in the course ENGR 1121 and can be easily maintained. The primary content covered by the material will be programming using MATLAB. All team members are subject matter experts and have taught or are currently teaching freshmen programming courses based on MATLAB.

An overview of each team member's roles and their primary responsibility is listed below:

- The project lead Dr. Priya Goeser pioneered MATLAB Marina which is still being used extensively and globally (189,328 pageviews, 21,540 users from August 1st, 2013 to

December 17th 2019, tracked by Google Analytics). She is also the instructor of record for ENGR 1121 on the Armstrong Campus. Dr. Goeser is a Professor in the Department of Mechanical Engineering and is currently the President-Elect of the American Society for Engineering Education (ASEE) Southeast Section, and she is very active in the scholarship of engineering education. She will coordinate the overall project, the design of the VLE and the development of new/updated tutorials.

- Dr. Thomas Murphy is an Associate Professor in the Department of Electrical and Computer Engineering. He developed all the primers and exercises on MATLAB Marina and is the instructor of record for the course Computing for Engineers (ENGR 1731) on the Armstrong Campus. This course is based solely on MATLAB. Dr. Murphy will work on the development of new/updated materials for the primers and exercises which serve as the text in the individual chapters/modules. Dr. Murphy has completed the Georgia Southern Teaching Online Courses (TOC) Workshop and the TOC Design Practicum and has online teaching and course development status for Georgia Southern.
- Mr. Chris Williams is a Lecturer in the Department of Computer Science on the Armstrong Campus and has experience with website and instructional design. He designed and developed the website for MATLAB Marina. Mr. Williams has experience teaching numerous programming courses in engineering, computer science and information technology and continues to be active in the scholarship of programming education. He will serve as the instructional designer for the team and focus on redesigning the overall website including all the modules housed on the VLE. Mr. Williams will also lead the efforts in developing self-assessment tools for students to use in every module.
- Dr. Jung Choi is an Assistant 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 oversee the identification of key modules that need to be developed and/or updated for the course and ensure that the modules follow the course and learning outcomes. Dr. Choi will also ensure that all sections of the course will use the VLE in lieu of the textbook beginning Spring 2021 and following semesters. He will organize a workshop every semester to provide training for all new instructors teaching the course, so they are well versed with the VLE and the teaching pedagogy needed for its successful implementation.
- Dr. David Calamas is the Undergraduate Program Coordinator and an Associate Professor in the Department of Mechanical Engineering. He is also the Technical Program Chair of the ASEE Southeast Section and has been active in engineering education. He is an instructor of record for ENGR 1121 on the Statesboro Campus and was actively involved in the creation of the course in 2015. Dr. Calamas is the Chair of the Assessment Committee in the Department of Mechanical Engineering and oversees program-level external accreditation by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). He will oversee the assessment and continuous improvement of the VLE after implementation.

The first 3 team members listed above are based on Georgia Southern's Armstrong Campus, and have worked together for 15 years and have collaborated on several scholarly and service

activities. They also have coauthored pedagogical papers based on their work on MATLAB Marina. They have known Dr. Calamas for about 5 years from their involvement in the ASEE. Dr. Goeser and Dr. Calamas have worked with Dr. Choi on multiple department level committees over the past three years. Overall the project team is inter-disciplinary and multi-campus and are equipped to work together in a coordinated team effort to make this transformation successful.

The transformation process will involve the following phases:

- Phase I: Designing the VLE
  - Identify modules that serve as book chapters/topics on MATLAB Marina that correspond to the topics covered in the course
  - Re-design the website to be more conducive to this course
  - Re-design the modules to be more interactive and provide students with a beneficial learning experience
- Phase II: Development of the VLE
  - Develop new modules and update existing ones to better align with the current course outcomes
  - Develop new and update existing multimedia tutorials for the modules
  - Convert the current primers (static texts posted as pdf documents) into interactive text on the modules
  - Create a bundled format of current primers and post it on the website as an optional downloadable e-book
  - Develop new and update the exercises for the modules
  - Ensure that all material is fully accessible
- Phase III: Implementation of the VLE in the course
  - Organize a workshop to introduce the VLE to all instructors of record for all sections. Also discuss the teaching pedagogy that will be used for its implementation.
  - Develop the student surveys and that will be used for assessment
  - Collect and evaluate comparative student performance data that can be used for continuous improvement and sustainability.

The VLE will be hosted on a Georgia Southern web server that is publicly accessible through the matlabmarina.com domain name. All course materials will be web-based and available to anyone with internet access. Self-assessment and practice exercises will be available through an open-access software application developed by the project team. This application will be distributed to faculty at other institutions upon request. After evaluating existing alternatives including the one developed by MathWorks, MATLAB Cody[3], which works well for self-assessment, the project team determined that having the ability to tailor an assessment application for the specific needs of students in ENGR 1121 would be more beneficial for this transformation.

References (for this section):

1. https://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab-programming-fall-2011/
2. https://www.mathworks.com/
3. https://www.mathworks.com/matlabcentral/cody/

4. Quantitative and Qualitative Measures

Quantitative Measures:

A pre-test and post-test will be given to students before and after taking the course to asses students' knowledge of MATLAB prior to and after taking the course. Student performance in the course will be measured by compiling aggregate grade distribution in all sections for in-class lab assignments, exams and projects (based on material in the VLE). This will be compared with the data from 2018-2020 (the semesters prior to implementation of the VLE). In addition, students also score the course textbook material as part of the end of the semester course evaluation implemented by the University. Data from this report will be compared with those in the prior semesters. Retention will be measured by comparing the fail/withdrawal rates (Georgia Southern does not have a drop rate) with those in the past semesters. Analytic data from the MATLAB Marina website (tracked by Google Analytics) and from the multimedia tutorials (posted as YouTube videos tracked by YouTube Analytics) will be examined to determine student usage of the VLE resources and materials. Data available through the analytics sources will be used to determine any trends or issues that might influence student usage and performance. Google and YouTube Analytics can also be used to assess if the usage is limited to certain geographic regions or if the use of the VLE is more global.

Qualitative Measures:

Surveys will be given to students to complete anonymously to determine their attitudes and perceptions of the class using a traditional textbook versus the VLE as their main instructional resource. These surveys will include inquiries about study time, specific resource usage, and preferences regarding textbooks versus VLE usage in this specific class. The surveys will be given at least two times a semester (when MATLAB is first introduced in the course and at the end of the MATLAB portion of the course). The surveys will intentionally include a combination of answering questions using a Likert scale and written comments to better assess the data obtained.

5. Timeline

February 2020:

- Two team members attend the Kick off Meeting
- Complete a student survey in the Spring 2020 sections of ENGR 1121 to get student suggestions on a 'user friendly' VLE
- Recruit student assistants for project.

March – April 2020:

- Compile student performance data from past semesters for quantitative assessment
- Complete Phase I: Designing the VLE

May - July 2020:

- Begin working on Phase II: Development of the VLE
    - Develop new modules and update existing ones
    - Develop new and update existing multimedia tutorials
    - Convert the current primers into interactive text on the modules

August 2020:

- Refine the teaching pedagogy for the VLE
- Meet and discuss the progress of the VLE and teaching pedagogy with all instructors of record for all sections of the course. Compile all feedback received from this discussion.

September – November 2020:

- Complete Phase II: Development of the VLE
    - Create the downloadable e-book
    - Develop new and update the exercises for the modules
    - Refine modules and teaching pedagogy based on feedback received

December 2020:

- Organize a 1-hour workshop for all instructors scheduled to teach ENGR 1121 in Spring 2021
- Develop a short 15-20 minutes webinar based on this workshop to use in subsequent semesters for any new faculty teaching the course for the first time

January – April 2021:

- Complete Phase III: Implementation of the VLE
    - Conduct pre/post-tests to asses student's knowledge of MATLAB
    - Compile all qualitative and quantitative data for assessment
- Maintain a live working document (google doc) that has a log of questions, suggestions, comments, etc. from all instructors teaching the course in Spring 2021. This document will serve as a 'teaching guide' that instructors can refer to in future semesters.
- Present and publish work in the following peer-reviewed conference: the American Society for Engineering Education Southeast Section Conference.

May 2021:

- Organize a 1-hour workshop for any new instructors scheduled to teach ENGR 1121 in Fall 2021. This workshop will also be used as debrief/brainstorm retrospective session to discuss the effectiveness of the VLE and teaching pedagogies with all instructors from Spring 2021.
- Analyze the VLE based on all the assessment data collected
- Complete a final report including suggestions for future semesters
- Contact faculty who teach similar courses at other USG institutions and share assessment data and teaching pedagogies.

June 2021:

- Present work 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.

6. Budget

Summer salary for Dr. Priya Goeser - $5000
Summer salary for Dr. Thomas Murphy - $5000
Summer salary for Mr. Chris Williams - $5000
Summer salary for Dr. Jung Choi - $4000
Summer salary for Dr. David Calamas - $4000
Student research assistants- $3000 (3 students; $10 per hour; 10 hours a week; for 10 weeks)
Camtasia 2019 (software): $507 ($169 x 3 licenses)
Website domain name renewal (9 years maximum) $115
Travel for kick off meeting: $800
Travel for at least one team member to present the work at two flagship conferences in engineering education:

- American Society for Engineering Education Southeast Section Conference in Fairfax, Virginia in March 2021: $500
- American Society for Engineering Education Annual Conference and Exposition in Long Beach, California in June 2021: $2000

Total cost - $29,922

7. Sustainability Plan

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 BSME 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 ensures that the VLE will be used as the primary resource for MATLAB in all sections of ENGR 1121 in Spring 2021 and subsequent semesters. At the end 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 starting from Spring 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. At least one team member will travel to disseminate this work at the ASEE Southeast Section Conference in March 2021 and one to the ASEE Annual Conference and Exposition in June 2021. This work will also be published in the scholarship of engineering education. All significant assessment results and effective teaching pedagogies will be shared with the faculty at other institutions (USG and beyond) at the above-mentioned conferences to encourage them to use the VLE in their programming courses.

The VLE will also be used as a supplemental resource in one section of ENGR 1731 at the Armstrong Campus, taught by one of the team members. A future proposal for a strategic transformation between multiple courses such as ENGR 1121 and ENGR 1731 across multiple departments is a long-term goal and part of the sustainability plan for this project.

Note: Letter of Support

Letter of support provided by Dr. Brian L. Vlcek, Department Chair and Professor, Department of Mechanical Engineering, Allen E. Paulson College of Engineering and Computing, Georgia Southern University