Mathematics Grants Collections   Mathematics

Spring 2016

College Algebra (College of Coastal Georgia)

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See next page for additional authors

Recommended Citation

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UNIVERSITY SYSTEM
OF GEORGIA

German Vargas, Jose Lugo, Laura Lynch, Jamil Mortada,
Treg Thompson, Victor Vega

College
Algebra

Grants Collection

Affordable Learning Georgia Grants Collections are intended to provide faculty with the frameworks to quickly implement or revise the same materials as a Textbook Transformation Grants team, along with the aims and lessons learned from project teams during the implementation process.

Each collection contains the following materials:

- Linked Syllabus
    - The syllabus should provide the framework for both direct implementation of the grant team's selected and created materials and the adaptation/transformation of these materials.
- Initial Proposal
    - The initial proposal describes the grant project's aims in detail.
- Final Report
    - The final report describes the outcomes of the project and any lessons learned.

Syllabus

MATH 1111: College Algebra

Bullet points without a link are still works-in-progress.

Chapter 1: Prerequisites

1.1 REAL NUMBERS: ALGEBRA ESSENTIALS

- Classifying Real Numbers
- Perform Calculations Using Order of Operations
- Using the commutative, associative, distributive, associative, inverse, and identity properties
- Evaluating algebraic expressions
- Simplify algebraic expressions

1.2 EXPONENTS AND SCIENTIFIC NOTATION

- Use the product rule of exponents
- Use the quotient rule of exponents
- Use the power rule of exponents
- Use the zero exponent rule of exponents
- Use the negative rule of exponents
- Find the power of a product and a quotient
- Simplify exponential expressions
- Use scientific notation

1.3 RADICALS AND RATIONAL EXPRESSIONS

- Evaluate Square roots
- Use the product rule to simplify square roots
- Use the quotient rule to simplify square roots
- Add and subtract square roots
- Rationalize denominators
- Use rational exponents

1.4 POLYNOMIALS

- Identify the degree and leading coefficient of polynomials

- Add and subtract polynomials
- Multiply polynomials
- Use FOIL to multiply binomials

1.5 FACTORING POLYNOMIALS

- Factor the greatest common factor of a polynomial
- Factor a trinomial
- Factor by grouping
- Factor a perfect square trinomial
- Factor a difference of squares
- Factor a sum and difference of cubes
- Factor expressions using fractional or negative exponents

Chapter 2: Equations and Inequalities

2.1 THE RECTANGULAR COORDINATE SYSTEMS AND GRAPHS

- Plot ordered pairs in a Cartesian coordinate system
- Graph equations by plotting points
- Graph equations with a graphing utility
- Find x-intercepts and y-intercepts
- Use the distance formula
- Use the midpoint formula

2.2 LINEAR EQUATIONS IN ONE VARIABLE

- Solve equations in one variable algebraically
- Solve a rational equation
- Find a linear equation (point and slope / two points)
- Given the equations of two lines, determine whether their graphs are parallel or perpendicular
- Write the equation of a line parallel or perpendicular to a given line

2.3 MODELS AND APPLICATIONS

- Set up a linear equation to solve a real-world application
- Use a formula to solve a real-world problem

2.4 COMPLEX NUMBERS

- Add and subtract complex numbers
- Multiply and divide complex numbers
- Simplify powers of i

2.5 QUADRATIC EQUATIONS

- Solve quadratic equations by factoring
- Solve quadratic equations by the square root property
- Solve quadratic equations by completing the square
- Solve quadratic equations by using the quadratic formula
- Solve quadratic equations with complex numbers

2.6 OTHER TYPES OF EQUATIONS

- Solve equations involving radicals (single radical, multiple radicals)
- Solve equations using factoring
- Solve radical equations
- Solve absolute value equations
- Solve other types of equations (rational)

2.7 LINEAR INEQUALITIES AND ABSOLUTE VALUE INEQUALITIES

- Use interval notation
- Use properties of inequalities (addition, multiplication)
- Solve inequalities in one variable algebraically
- Solve absolute value inequalities
- Compound Inequalities (and inequalities / orinequalities)

11.1 SYSTEMS OF LINEAR EQUATIONS: TWO VARIABLES

- Solve systems of equations by graphing
- Solve systems of equations by substitution
- Solve systems of equations by addition (elimination)
- Identify inconsistent systems of equations containing two variables
- Express the solution of a system of equations containing two variables

11.3 SYSTEMS OF NONLINEAR EQUATIONS AND INEQUALITIES: TWO VARIABLES

- Solve a system of nonlinear equations using substitution
- Solve a system of nonlinear equations using elimination
- Graph a nonlinear inequality (Quadratic)
- Graph a system of nonlinear inequalities

Chapter 3: Functions

3.1 FUNCTIONS AND FUNCTION NOTATION

- Determining whether a relation represents a function
- Find the value of a function
- Determine whether a function is one-to-one
- Use the vertical line test to identify functions
- Use the horizontal line test to identify one-to-one functions
- Graph the functions in the library of functions

3.2 DOMAIN AND RANGE

- Find the domain of a function identified by an equation
- Find the range of a function
- Domain and Range with a graph
- Graph piecewise-defined functions

3.3 RATES OF CHANGE AND BEHAVIOR OF GRAPHS

- Find the average rate of change of a function on an interval

- Use a graph to determine where a function is increasing, decreasing, or constant
- Analyzing the library of functions for increasing and decreasing intervals
- Use a graph to locate the absolute maximum and absolute minimum

3.4 COMPOSITION OF FUNCTIONS

- Combine functions using algebraic operations (addition, subtraction, multiplication, division)
- Create a function by composition of functions
- Evaluate composite functions (formula, table, graph)
- Find the domain of a composite function
- Decomposing a composite function into its component functions

3.5 TRANSFORMATION OF FUNCTIONS

- Graph functions using horizontal and vertical shifts
- Graph functions using reflections about the axes
- Graph functions using stretches and compressions
- Perform a sequence of transformations

3.6 ABSOLUTE VALUE FUNCTIONS

- Graph the absolute value function

3.7 INVERSE FUNCTIONS

- Verify that two functions are inverses
- Find domain and range of inverse functions
- Find and evaluate inverse functions (linear, quadratic, radical, rational)
- Find inverse functions and their graphs

Chapter 4: Linear Functions
4.1 LINEAR FUNCTIONS

- Represent a linear function
- Determine whether a linear function is increasing, decreasing, or constant
- Interpret slope as a rate of change
- Write and interpret an equation for a linear function
- Model real-world problems with linear functions
- Graph linear functions
- Write the equation for a function from the graph of a line

4.2 MODELING WITH LINEAR FUNCTIONS

- Build linear models from verbal descriptions

4.3 FITTING LINEAR MODELS TO DATA

- Draw and interpret scatter diagrams
- Use a graphing utility to find the line of best fit
- Distinguish between linear and nonlinear relations
- Fit a regression line to a set of data and use the linear model to make predictions

Chapter 5: Polynomial and Rational Functions

5.1 QUADRATIC FUNCTIONS

- Recognize characteristics of parabolas
- Find domain and range of a quadratic function
- Determine a quadratic function's maximum or minimum value

5.2 POWER FUNCTIONS AND POLYNOMIAL FUNCTIONS

- Identify polynomial functions
- Identify the degree and leading coefficient of a polynomial function

5.3 GRAPHS OF POLYNOMIAL FUNCTIONS

- Use factoring to find zeros of polynomial functions

- Identify zeros and their multiplicities
- Determine end behavior for polynomial functions
- Graph polynomial functions
- Use the intermediate value theorem

5.4 DIVIDING POLYNOMIALS

- Use long division to divide polynomials
- Use synthetic division to divide polynomials

5.5 ZEROS OF POLYNOMIAL FUNCTIONS

- Evaluate a polynomial using the remainder theorem
- Use the factor theorem to solve a polynomial equation
- Use the rational zero theorem to find rational zeros
- Find the zeros of polynomial functions
- Use the Fundamental Theorem of Algebra
- Use the linear factorization theorem to find polynomials with given zeros
- Use Descartes' Rule of Signs

5.6 RATIONAL FUNCTIONS

- Use arrow notation (local behavior)
- Find domain of rational functions
- Identify vertical asymptotes of rational functions
- Identify horizontal asymptotes of rational functions
- Identify slant (oblique) asymptotes of rational functions
- Graph rational functions
- Write rational functions

5.7 INVERSES AND RADICAL FUNCTIONS

- Find the inverse of a polynomial function (linear, quadratic)
- Restrict the domain to find the inverse of a polynomial function

5.8 MODELING USING VARIATION

- Solve direct variation problems
- Solve inverse variation problems
- Solve problems involving joint variation

Chapter 6: Exponential and Logarithmic Functions

6.1 EXPONENTIAL FUNCTIONS

- Identify exponential functions
- Evaluate exponential functions
- Find equations of exponential functions
- Apply compound interest formula
- Continuous growth/decay

6.2 GRAPHS OF EXPONENTIAL FUNCTIONS

- Graph exponential functions
- Graph transformations of exponential graphs

6.3 LOGARITHMIC FUNCTIONS

- Convert from logarithmic to exponential form
- Convert from exponential to logarithmic form
- Use common logarithms
- Use natural logarithms

6.4 GRAPHS OF LOGARITHMIC FUNCTIONS

- Find the domain of a logarithmic function
- Graph logarithmic functions
- Graph transformations of logarithmic functions

6.5 LOGARITHMIC PROPERTIES

- Use the product rule for logarithms
- Use the quotient rule for logarithms

- Use the power rule for logarithms
- Expand logarithmic expressions
- Condense logarithmic expressions
- Use the change of base formula for logarithms

6.6 EXPONENTIAL AND LOGARITHMIC EQUATIONS

- Use like bases to solve exponential equations
- Solve exponential equations using logarithms
- Use the definition of logarithm to solve logarithmic equations
- Use one-to-one property of logarithms to solve logarithmic equations
- Solve applied problems using exponential and logarithmic equations

6.7 EXPONENTIAL AND LOGARITHMIC MODELS

- Model exponential growth and decay
- Use logistic growth models
- Choose an appropriate model for data

6.8 FITTING EXPONENTIAL MODELS TO DATA

- Build an exponential model from data
- Build a logarithmic model from data
- Build a logistic model from data

Initial Proposal

Affordable Learning Georgia Textbook Transformation Grants
Round 2
Summer 2015, Fall 2015, Spring 2016
Proposal Form and Narrative

Institution Name(s)	College of Coastal Georgia
Team Members (Name, Title, Department, Institutions if different, and email address for each)	1. Jose Lugo, Assistant Professor of Mathematics, jlugo@ccga.edu 2. Laura Lynch, Assistant Professor of Mathematics, llynch@ccga.edu 3. Jamil Mortada, Assistant Professor of Mathematics, jmortada@ccga.edu 4. Treg Thompson, Assistant Professor of Mathematics, tthompson@ccga.edu 5. German Vargas, Department Chair and Assistant Professor of Mathematics, gvargas@ccga.edu 6. Victor Vega, Associate Professor of Mathematics, vvega@ccga.edu
Sponsor, Title, Department, Institution	Lance Carluccio, Interim Vice President for Academic Affairs, College of Coastal Georgia.
Course Names, Course Numbers and Semesters Offered (Summer 2015, Fall 2015, or Spring 2016)	1. College Algebra, MATH 1111, Summer/Fall/Spring 2. Trigonometry, MATH 1112, Summer/Fall/Spring 3. Precalculus, MATH 1113, Fall/Spring 4. Probability and Statistics, MATH 2112, Summer/Fall/Spring

Average Number of Students Per Course Section	By course: 1. 31 2. 27 3. 28 4. 37	**Number of Course Sections Affected by Implementation in Academic Year 2016**	By course: 1. 29 2. 6 3. 4 4. 19	**Total Number of Students Affected by Implementation in Academic Year 2016**	By course: 1. 899 2. 162 3. 112 4. 703

Award Category (pick one)	☐ No-Cost-to-Students Learning Materials ☐ OpenStax Textbooks ☐ Course Pack Pilots ☒ Transformations-at-Scale

List the original course materials for students (including title, whether optional or required, & cost for each item)	By course: 1. College Algebra: Graphs And Models 5e W/MML, Bittinger 2. Trigonometry 8e W/WebAssign, Larson 3. Precalculus 8e W/Webassign, Larson 4. Essentials of Statistics 4e W/MML, Mario Triola	Cost of Text + LMS by course: 1. $219.75/student 2. $306.75/student 3. $342.00/student 4. $168.75/student Projected total cost: **$404,184 annually**	
Plan for Hosting Materials	☐ OpenStax CNX ☒ D2L ☐ LibGuides ☐ Other _____		
Projected Per Student Cost	By course: 1. $32.95 2. $0 (Cont. course) 3. $32.95 4. $32.95	**Projected Per Student Savings (%)**	By course: 1. 85% 2. 100% 3. 90% 4. 80%

1. PROJECT GOALS

The goal of this project is to promote access and affordability of higher education by adopting low cost alternatives of the textbooks and other educational resources currently used in high enrollment courses without compromising the standards in these courses. In particular, we want to transform 4 of the Top 50-enrolled USG lower-division Core Curriculum courses to adopt OpenStax textbooks. This at-scale transformation will impact a large number of students at our institution as these are the main Area A and D courses for many of our programs and any effort to increase the retention and passing rates in these courses will hence be an effort to increase our general retention, progression and graduation rates.

1.1 STATEMENT OF TRANSFORMATION

Most of the students at College of Coastal Georgia take one Mathematics course in Area A (Essential Skills) and one Mathematics course in Area D (Science and Math). With the rapid increase in the price of textbooks, the required materials for these courses have become a barrier to access and completion, specially for institutions like CCGA that serve a large percentage of low income students, as evidenced by the percentage of Pell Grant recipients (53% based on fall 2013 total enrollment).

The target of this transformation is to adopt low cost textbook and materials for the following 4 courses: College Algebra (MATH 1111), Trigonometry (MATH 1112), Precalculus (MATH 1113), Probability and Statistics (MATH 2112). We expect to deliver a staged transformation starting with an at-scale transformation for MATH 2112 by fall 2015, followed by pilot stages for MATH 1111, 1112, 1113 during the fall of 2015 and the full implementation by spring of 2016.

The broad focus of this initiative will target almost every student at CCGA and we expect not only to make college more affordable for those that we already serve but also to help bridge that gap that maintains many potential students from considering college as an opportunity for upward mobility.

1.2 TRANSFORMATION ACTION PLAN

As the impact of this transformation affects multiple courses and multiple sections, the changes will require concerted efforts throughout the Department of Mathematics and many of our faculty will be participating in different roles to make this transformation successful.

Dr. Victor Vega and Dr. German Vargas will lead this project and will be the participants in the grant kick-off meeting. Dr. Vega will oversee the project internally; he will be in charge of generating the reports and maintaining the project on schedule by reaching the milestones set forth in the timeline. Dr. Vargas will lead the project externally; he will be the liaison with the USG's Academic Advisory Committee on Mathematical Subjects (ACMS) and will capitalize on the efforts by the Regent's Academic Committee on Libraries (RACL) and efforts by other disciplines at different schools of the USG, with

the intention of using this synergy to generate the momentum needed to propel these changes college and system-wide and across disciplines.

Dr. Vega and Dr. Vargas will also work on the creation of ancillary resources for instruction of MATH 2112 Probability and Statistics. In particular they will create the PowerPoint presentations that will be used for classroom instruction of this course. Dr. Jamil Mortada will create equivalent resources for MATH 1111 College Algebra, and Dr. Jose Lugo will create those for MATH 1112 Trigonometry. The created resources for these last two courses will satisfy the needs for MATH 1113 Precalculus as this course is comprised of the material of MATH 1111 and MATH 1112.

Dr. Laura Lynch will be in charge of the alignment of the course content to our master syllabi and any modifications needed as we adopt these new textbooks. She will be in charge of the assessment of the initiative by requesting qualitative feedback from students and faculty, and by comparing the quantitative results of our current General Education assessment with the results obtained after the transformation.

Mr. Treg Thompson will be in charge of the creation of a webpage that will link the topics presented in each of the courses to specific additional open resources like Khan Academy and The Annenberg Foundation's Learner.org.

The links to all the free educational resources will be delivered in each of the courses through D2L.

1.3   QUANTITATIVE AND QUALITATIVE MEASURES

To measure the quantitative impact of the newly adopted OpenStax text and ancillary resources (homework system, PowerPoints, and links) for each course, we will use the grade distribution in all the impacted courses (including DFW rates), and the students' performance in our General Education Assessment, to perform longitudinal comparisons with said data from current and previous years. We do not anticipate any decrease in performance at the student learning outcome level, and by increasing the accessibility of the resources we hope to decrease the DFW rates.

To measure the qualitative impact of the open resources on the students, we will compare the university faculty and course evaluation (FACE) survey for each of the impacted courses before and after implementation. In addition, we will ask students to complete a questionnaire about the resources. The questionnaire will include questions such as:
1. Are you satisfied with the quality of the textbook?
2. Are you satisfied with the quality of the online homework system?
3. Are you satisfied with the quality of the additional resources (e.g., links, PowerPoints) provided with your course?
4. Are you satisfied with the quantity of the additional resources (e.g., links, PowerPoints) provided with your course?

5. Do you wish the instructors in your other courses would adopt open-source texts and software?
6. Do you think that using no-cost, open source-educational resources has been detrimental to this course and to your learning in this course?

The questionnaire will also include the following short response question: "Do you have any further comments or recommendations in regard to the textbook, homework system, PowerPoints, or links to additional resources?"

Since the newly adopted open-source texts would be the first in the department and the college, it is of utmost importance to measure the qualitative impact on the faculty as well. We will also ask the faculty to complete a similar questionnaire to gauge their satisfaction with the text and determine if more edits need to be made to the text and resources.

1.4   TIMELINE

May 2015
- Finish the review the e-textbooks and map the concepts and learning objectives of the course to the sections of the texts.

June - August 2015
- Modification of master syllabi for MATH 1111, MATH 1112, MATH 1113, MATH 2112 to align with OpenStax textbooks.
- Creation of the PowerPoint presentations for MATH 1111, MATH 1112, and MATH 2112 to start the offerings on fall 2015. (At-scale for MATH 2112)
- Create assignments in WebAssign for each course.
- Design a reflective survey for students in Qualtrics

November 2015
- Administer reflective survey for MATH 2112 students in Qualtrics

December 2015
- Administer FACE survey to students

January 2016
- At-scale course offerings with OpenStax textbooks in College Algebra, Precalculus and Trigonometry start in the Spring Semester 2016.

February – March 2016
- Discussion and assessment of the courses offered
- Preliminary report on the implementation

April 2016
- Administer reflective survey for MATH 1111, MATH 1112, MATH 1113, MATH 2112 students in Qualtrics

May 2016
- Administer FACE survey to students
- Evaluation and analysis of results per course

June 2016
- Presentation of findings and assessment of each course

1.5 BUDGET

Each of the 6 team members will receive equal compensation (stipend plus benefits) for their participation in this project as explained in the action plan. An additional $800 will be allocated for additional project expenses including the travel expenses for two members to the required in-person kick-off meeting. The distribution of the funds will be as follows:

Team Member	Stipend	FICA and FICA-Med (7.65%)	ORP (9.24%)	TRS (13.15%)	Allocation for travel expenses	Total
Victor Vega	$4,163.45	$318.50	$384.70		$400.00	$5,266.65
German Vargas	$4,163.45	$318.50	$384.70		$400.00	$5,266.65
Jamil Mortada	$4,163.45	$318.50	$384.70			$4,866.65
Jose Lugo	$4,028.69	$308.19		$529.77		$4,866.65
Laura Lynch	$4,163.45	$318.50	$384.70			$4,866.65
Treg Thompson	$4,163.45	$318.50	$384.70			$4,866.65
					Total	$29,999.90

1.6 SUSTAINABILITY PLAN

- As in the past, the courses will be offered each fall, spring and summer (as needed). All courses will now use the free open educational resources.

- Each course resource will be reviewed by the associated faculty member(s) as listed above prior to the beginning of the semester in which the course is taught.

- Based on student survey results (see timeline), changes in the content and organization of the course will be implemented as needed.

- Alignment within the OER materials and the associated course objectives and activities in the course syllabus will be reviewed by the program faculty annually and adjustments will be made as appropriate.

- We do not expect any additional expenses to be added as all materials will be available and we just need to fine-tune the resources as we progress in the adoption and implementation.

1.7 REFERENCES & ATTACHMENTS

Butcher, N. (2011). *A basic guide to open educational resources (oer).* A. Kanwar, & S. Uvalic-Trumbic (Eds.). Retrieved from
http://www.col.org/PublicationDocuments/Basic-Guide-To-OER.pdf.
Trombitas, K. (2012, July). *Financial stress: An everyday reality for college students.*
Retrieved from
https://www.cgsnet.org/ckfinder/userfiles/files/1nceptia FinancialStresswhitepaper.pdf

ATTACHMENTS

Letter of Support: Dr. Lance Carluccio, Vice President of Academic Affairs
Dr. Keith Belcher, Dean School of Arts and Sciences

PROPOSAL SUBMISSION: ALL PROPOSAL DOCUMENTS, REFERENCES, AND ATTACHMENTS MUST BE SUBMITTED IN A SINGLE EMAIL TO ALG@GATECH.EDU.

DEADLINE FOR CATEGORIES 1-3: 5:00 PM, NOVEMBER 30, 2014

DEADLINE FOR CATEGORY 4: 5:00 PM, DECEMBER 8, 2014

COLLEGE *of*
COASTAL
GEORGIA
UNIVERSITY SYSTEM OF GEORGIA

Dreams in Action
TM

VICE PRESIDENT FOR ACADEMIC AFFAIRS

MEMORANDUM

TO: Dr. German Vargas
                Department Chair, Mathematics

FROM: Dr. Lance Carluccio   *Lance Carluccio*
                Interim Vice President for Academic Affairs

RE: Affordable Learning Georgia Textbook Transformation Grant Application
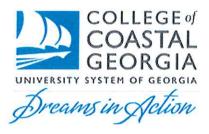
DATE: December 4, 2014

This memo is to commend you and the other faculty of the mathematics department for the coordinated plans and the proposal to significantly reduce the cost of textbooks for students across four mathematics courses with multiple sections. The courses affected by this proposal include: College Algebra; Trigonometry; Precalculus; and Probability and Statistics. Close to 2000 students in almost 60 sections of courses each academic year will benefit from this major transformation to more affordable material for learning. This will have significant impact on retention and progression goals in that it will make textbook type material more accessible to those who have limited financial resources.

In addition to the above, the faculty of the mathematics department are demonstrating the type of impact that faculty can have in significantly making college more affordable and reducing student debt.

I strongly support this grant application and the efforts of the faculty involved in this project.

December 4, 2014

Affordable Learning Georgia
Textbook Transformation Grants

To whom it may concern:

It is my pleasure to express my support for the Department of Mathematics at the College of Coastal Georgia's proposal related to access and affordability of lower cost alternatives of textbooks. As an open access institution many of our students take more than one mathematics course in their chosen program of study. This coupled with the fact that textbook costs are consistently increasing often presents financial stress to students with limited means. This proposal will have a broad impact on multiple courses and sections offered within the institution. The department working together focused on four courses offered by the mathematics department that impact the majority of our students. Each faculty member involved in the development of the grant will also play very different but significant roles ensuring that the textbook transformation will be successful. Resources will be provided that will link to the college's D2L learning platform and mathematics webpage. Qualitative and quantitative assessment measures will be developed and used to evaluate general education outcomes. The proposal has been well designed and discussed throughout the mathematics department. The plan is sustainable with no extra costs associated other than those detailed in the budget for the grant implementation. The successful implementation of this project will ultimately increase retention, pass rates and progression to graduation.

Sincerely,

Keith E. Belcher, PhD., MLS^{CM} (ASCP) SM
Professor of Biology and Clinical Laboratory Science
Dean, School of Arts and Sciences
College of Coastal Georgia

Final Report

Affordable Learning Georgia Textbook Transformation Grants

Final Report

Instructions:

A. Your final report submission must include four separate component files:

1. *Completed report form. Please complete per inline instructions. The italicized text is provided for your assistance; please delete the italicized text before submitting your report.*
2. *Course Outline document with links to the materials as used per day, week, or unit, organized chronologically. [View Course Outline Example](#)*
   a. *For each resource, give the title, author, Creative Commons licenses (if appropriate), and freely accessible URL to the material. Include all open-access links to all adopted, adapted, and newly created course materials.*
3. *Supporting data on the impact of your Textbook Transformation (survey, analyzed data collected, etc.)*
4. *A photograph of your team and/or your students for use in ALG website and materials.*
   a. *Photograph must be 800x600 pixels at minimum (length x height).*
   b. *Photograph must be taken together: individual team member photographs and website headshots not accepted.*

B. Go to http://affordablelearninggeorgia.org/site/final_report_submission to submit these four components of your final report. Follow the instructions on the webpage for uploading your documents. You will receive a confirmation email. Based on receipt of this report, ALG will process the final payment for your grant. ALG may follow up with additional questions or to request your participation in a publication, presentation, or other event.

Date: 5/20/16

Grant Number: 116

Institution Name(s): College of Coastal Georgia

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

1. Jose Lugo, Assistant Professor of Mathematics, jlugo@ccga.edu
2. Laura Lynch, Department Chair and Assistant Professor of Mathematics, llynch@ccga.edu
3. Jamil Mortada, Assistant Professor of Mathematics, jmortada@ccga.edu
4. Treg Thompson, Assistant Professor of Mathematics, tthompson@ccga.edu
5. German Vargas, Assistant Vice President for Academic Student Engagement and Associate Professor of Mathematics, gvargas@ccga.edu
6. Victor Vega, Interim Dean, School of Arts and Sciences and Associate Professor of Mathematics, vvega@ccga.edu

Project Lead:

German Vargas / Victor Vega

Course Name(s) and Course Numbers:

MATH 1111: College Algebra

MATH 1112: Trigonometry

MATH 1113: Precalculus

MATH 2112: Probability and Statistics

Semester Project Began:

Summer 2015

Semester(s) of Implementation:

Summer 2015, fall 2015, spring 2016

Average Number of Students Per Course Section:

	Number of Sections	Total Number of Students	Average Number of Students
Summer 2015			
MATH 2112	3	53	18
Fall 2015			
MATH 1111	12	465	39
MATH 1112	3	64	21
MATH 1113	2	52	26
MATH 2112	8	261	33
Spring 2016			
MATH 1111	10	285	29
MATH 1112	3	80	27
MATH 1113	1	20	20
MATH 2112	10	352	35
Total	52	1632	31

Number of Course Sections Affected by Implementation: See above

Total Number of Students Affected by Implementation: See above

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
     The goal of this project was to promote access and affordability across our institution, which aligns well with our institutional mission and strategic goals which emphasize student success and service to the community. We are very excited about the impact this project has had and the student savings that it has generated, but we also understand that change will often create discomfort, and we knew that a radical and at-scale transformation like this one was not going to come without challenges. In general, one of the challenges from this project was associated to the bold approach of implementing all the changes at scale throughout all the sections, which in some cases resulted in difficulties like those caused by XYZ Homework because of its lack of robustness. Even though this approach was bold and risky, we felt compelled to replace our current textbooks and online homework platforms immediately and at scale; we could not continue expecting our student to pay $200 to $300 per course for a resource that we knew could be matched by an open educational resource. After our final semester of implementation, we are very pleased with the results and we are proud of the large amounts of savings generated, but we will still be vigilant to new opportunities to keep improving the deployment and implementation of OERs.
   - Transformative impacts on your instruction
     This transformation has given us the opportunity to adapt to a new paradigm in instruction and we have had to compensate the areas in which the selected OERs are falling short. We have had to move far away from our comfort zone of Pearson products, with their robust online platform (MyMathLab), and their prebuilt course materials and ancillary resources. We had to create the ancillary resources, adapt and adjust to new homework platforms, and we are still having challenges with the way that the material is presented in the College Algebra component of the OpenStax Algebra and Trigonometry textbook. We are pleased however with the trigonometry component of the book, and we are pleased with the Introductory Statistics textbook.
   - Transformative impacts on your students and their performance
     The impact on student performance has been neutral, which was the optimistic and anticipated result from the transformation. However, the perceptions of the materials used in the course have had mixed reviews. From the feedback received by students (refer to the ALG Survey Results document) it is clear that the regular use of the eBook is not prevalent throughout the courses, and this can be attributed to discontent of the general delivery of the content in the eBook as perceived by both

faculty and students. However, this issue is not unique to OER or OpenStax, and faculty and student face similar challenges with traditional textbooks. Once again, we experienced more issues with the College Algebra content than the content for Trigonometry and for Statistics.

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

This has been an interesting collaborative process in our department, and we have learned to work hard through challenges and discomforts. As an example, we ventured to adopt a low cost online homework platform (XYZ Homework) and after trying to overcome some of its shortcomings, we had to reevaluate at the middle of the project, and we switched to WebAssign for all our courses using OpenStax (at the beginning of fall 2015 WebAssign was only available for Probability and Statistics and not for the College Algebra/Trigonometry/Precalculus). As a general lesson learned, if you are an early adopter you need to be willing to explore and adapt; the higher education environment is changing rapidly and we need to be agile to react to the availability of new resources specially if these promote access and affordability for our students.

2. **Quotes**

- Provide three quotes from students evaluating their experience with the no-cost learning materials.
    - *I think the online homework, online books (free and paid) are great for the education process. Any where there is an internet connection, the students have the ability to access all of their materials. There is a minor benefit in teaching all students how to navigate the internet and use resources in a new method. / / The biggest issue I have with the homework is a personal issue. I find my stats class to be difficult, at not fault to the teacher. The subject is one I struggle with. My issues with the homework comes from having the ability to answer the same question 5 times before the site permanently marks it wrong. In my algebra class last semester, I used the opportunity to try the question again as a coaching tool to figure out what I did wrong and solve the problem correctly. With the class I am struggling with, Stats, Im using the multiple chances to answer as a way to increase the likelihood of a good grade without taking the time to learn what I did wrong and how to solve correctly. Applying this to any subject and any student, it boils down to a person's willingness to push beyond discomfort to excel at learning the material. / / I still prefer the online homework system.*
    - *Other than having to meet with the Professor or SI, I found it difficult to find the "why" and "how" form the textbooks. This made learning the material more difficult. Improved examples in the textbook would likely generate better understanding of the material. While some problems displayed excellent data for solving a problem, it was not always the case for webassign related question increasing the difficulty of solving problems by myself.*
    - *The online textbook was confusing and was never used in the classroom, so the format was completely different from the professor's teaching style. The homework on*

webassign was difficult and the textbook was no help in finding solutions to the problems. Webassign also would not show you the steps to finding a correct answer. You can open a practice question, but it only shows you if you're correct or not, then it displays the correct solution with no explanation of how it was reached. My experience with mymathlab online homework was much better. That site would help you learn the math, rather than just evaluating your current knowledge. Homework is useless if the student doesn't learn the concepts.

3. Quantitative and Qualitative Measures

3a. Overall Measurements

Student Opinion of Materials

Was the overall student opinion about the materials used in the course positive, neutral, or negative?

Students enrolled during fall 2015 and spring 2016 were asked to provide feedback about their experience using OpenStax books. A total of 277 students completed the survey.

Highlights:

- 31% of the students use the books sometimes, most of the time, or always. The majority of those who did not use the book indicated that they did not need to do so.
- Students who used the book, were asked to provide feedback regarding specific characteristics of the book. Most students answered "Moderately Useful" or "Very Useful" for examples and accessibility (62% and 70% of students, respectively). However, most students answered only "somewhat useful" and "moderately useful" for the explanations (70%), layout (63%), amount of material per section (68%), and amount of material per chapter (71%).
- For students who have used online textbooks before, 75% reported that the quality of the OpenStax book was about the same as other free electronic books, while 16% indicated it was better.
- When comparing OpenStax books to math textbooks in general, 55% reported that the quality of the OpenStax book was about the same as other free electronic books, while 22% indicated it was better.
- Overall, students in the Precalculus courses were evenly split in their answer as to whether the resources were detrimental while 76% of the Statistics students did not believe they were. Separate from that issue, a majority of students did believe more instructors should consider adopting lower cost resources.

Complete survey results attached as separate document

Total number of students affected in this project: 1632

- Positive: 44 % of 277 number of respondents
- Neutral: 26 % of 277 number of respondents
- Negative: 30 % of 277 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?

Choose One:
- ___ Positive: Higher performance outcomes measured over previous semester(s)
- _X_ 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?

MATH 1111: DFW rates increased from previous falls, but remain the same for the spring term.

MATH 1112: DFW rates slightly increase from previous falls, and decreased for the spring term.

MATH 1113: DFW rates decreased from previous falls, as well as previous springs.

MATH 2112: DFW rates obtained in the terms following the implementation were similar to those prior to implementation

The overall comparative impact on DFW rates in the semesters of implementation over previous semesters is neutral.

	Prior to Implementation		After Implementation	Prior to Implementation		After Implementation
	Fall 2013	Fall 2014	Fall 2015	Spring 2014	Spring 2015	Spring 2015
MATH 1111	33%	34%	44%	43%	40%	42%
MATH 1112	30%	39%	41%	38%	43%	34%
MATH 1113	35%	29%	25%	59%	63%	40%
MATH 2112	38%	30%	38%	32%	36%	33%

Drop/Fail/Withdraw Rate:

36% of students, out of a total 737 students affected, dropped/failed/withdrew from the course in the final semester of implementation.

Choose One:

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

3b. Narrative

As indicated above, the impact of the transformation has been in access and affordability but has been neutral in academic achievement and performance. The DWF rates in the courses has been compared fall-to-fall, and spring-to-spring to reduce possible confounding variables, and the general results do not indicate any positive or negative impact of the transformation. Qualitatively however, the feedback received from the students is indicative of dissatisfaction with the ebook and the online homework platforms. Even though most of the students (67%) wish their instructors in other classes would also adopt free/low cost textbooks and software, many of them expressed concerns of the quality of both the ebook and the online homework platform. For a thorough analysis of the survey results please refer to the ALG Survey results document.

4. Sustainability Plan

Thanks to the support from Affordable Learning Georgia, we have already developed all the ancillary materials necessary for instruction in the four courses. We have also compiled a list of additional resources that link each of the sections covered in these 4 courses with the textbook and videos from websites like Khan Academy and The Annenberg Foundation's Learner.org. (See www.ccga.edu/mathlinks)

We will keep exploring emerging technologies and online homework platforms, but for now we will keep using WebAssign, which is proving to have the robustness necessary to support an at-scale implementation.

5. Future Plans

Our positive experience with the ALG transformation grant is permeating to other areas in our institution, and we are actively promoting the adoption of OERs in other disciplines like Psychology, Sociology, Chemistry, Biology. The Economics faculty have

already adopted OERs, and we are hoping to have enough options within the different areas of the core curriculum to allow a student to complete areas A through E (Area F still presents more challenges) while taking courses with low/zero cost of materials.

As additional OER materials are being released every day, we will make sure to include at least one open textbook in the evaluation and selection of new materials for every Mathematics course in our department.

6. Description of Photograph

Even though our ALG transformation team consisted of 6 members, all the faculty in the department of mathematics were actively involved in instruction, evaluation and assessment of all the open educational resources. All the faculty in the photograph taught one of the 4 courses impacted by the transformation and continue to provide valuable feedback as we move forward. Pictured (from left to right): Dr. Syvillia Averett, Mr. James Holt, Dr. Laura Lynch, Mr. Treg Thompson, Ms. Sheila Ledford, Dr. Renren Zhao, Dr. Jose Lugo, Dr. German Vargas, Dr. Victor Vega, and Dr. Courtenay Miller.