Summer 2017

Quantitative Skills and Reasoning (Armstrong)

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UNIVERSITY SYSTEM
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Tricia Brown & Joshua Lambert

Quantitative Skills and Reasoning

Affordable Learning Georgia

Georgia's Virtual Library
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An Initiative of the University System of Georgia

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.

Initial Proposal

Application Details

Manage Application: ALG Textbook Transformation Grants Round Five

Award Cycle:	Round 5
Internal Submission Deadline:	Tuesday, December 15, 2015

Application Title:	210
Submitter First Name:	Tricia
Submitter Last Name:	Brown
Submitter Title:	Associate Professor
Submitter Email Address:	patricia.brown@armstrong.edu
Submitter Phone Number:	912-344-3244
Submitter Campus Role:	Proposal Investigator (Primary or additional)
Applicant First Name:	Tricia
Applicant Last Name:	Brown
Co-Applicant Name(s):	Joshua Lambert
Applicant Email Address:	patricia.brown@armstrong.edu
Applicant Phone Number:	912-344-3244
Primary Appointment Title:	Associate Professor
Institution Name(s):	Armstrong State University

Team Members (Name, Title, Department, Institutions if different, and email address for each. Include the applicant in this list.):

Dr. Tricia Muldoon Brown, Associate Professor of Mathematics, patricia.brown@armstrong.edu

Dr. Joshual Lambert, Associate Professor of Mathematics, joshua.lambert@armstrong.edu

Sponsor, (Name, Title, Department, Institution):

Dr. James Brawner, Professor and Head, Department of Mathematics

Proposal Title: 210

Course Names, Course Numbers, and Semesters Offered:

Quantitative Skills and Reasoning, MATH 1001, Spring 2016, Fall 2016, Spring 2017

Final Semester of Instruction (This is your final semester of the project):	Spring 2017
Average Number of Students per Course Section:	20.2
Number of Course Sections Affected by Implementation in Academic Year:	27
Total Number of Students Affected by Implementation in Academic Year:	545
List the original course materials for students (including title, whether optional or required, & cost for each item):	Using & Understanding Mathematics (w/NewMyMathLab) Edition: 6th, Required - $227.50
Proposal Categories:	Specific Top 50 Lower Division Courses
Requested Amount of Funding:	$10,800
Original per Student Cost:	$227.50
Post-Proposal Projected Student Cost:	$0
Projected Per Student Savings:	$227.50
Plan for Hosting Materials:	Other

Project Goals:

The project goal is to create and adopt an open-source, multimedia textbook and online homework system for the mathematics core course, Quantitative Skills and Reasoning. This interactive textbook aims to engage students, alleviate financial burden, and promote academic success.

Statement of Transformation:

For this proposed project we intend to apply a textbook transformation to the text used by Armstrong State University in its core mathematics class for non-science majors. In a typical academic year approximately 545 Armstrong State University students take Quantitative Skills and Reasoning also known as MATH 1001. This one-semester course satisfies the essential skills mathematics requirement for non-science majors and provides core mathematics credit across the University System of Georgia. The current text, including the accompanying

MyMathLab online homework system, costs $227.50 at the campus bookstore. While students may be able to rent a book or buy a used book at a reduced price, the online homework is non-transferable so students must always pay full price for the MyMathLab access code. Selling for $127.50, an online access code from the bookstore is still quite expensive. At Armstrong, many of our students find the cost of textbooks a burden. In Fall 2014, 30% of the student body were nontraditional students over 24 years of age. Many of these students are already struggling to balance academic life and family obligations and the further financial pressure can have an impact on their academic achievement. Armstrong also hosts a large percentage of first-generation college students; 31% in Fall 2014. These students often come from working-class families who are unable to provide extra financial support. Anecdotally, we have had students in our classes who have failed to purchase required course materials and consequently underachieved in the classes. In these cases, the cost of a textbook can make the difference between academic success and failure.

Textbook costs and fees to access to online homework continue to grow and increase the burden upon students. While these resources are necessary to the education, the cost is not. An open-source textbook for Quantitative Skills and Reasoning would help relieve the hardship on the over 500 students taking this course each year. The economic effect will be great; even with a conservative estimate it would save Armstrong students well over $60,000 in the first year of implementation alone. Within the department, we hope the proposal would also have a positive effect. There is some dissatisfaction with the current text and a new textbook designed specifically for the needs of the Armstrong students should produce more faculty contentment as well as a better product in the classroom.

Transformation Action Plan:

After completing an extensive search for open-source textbooks in Quantitative Skills and Reasoning from resources such as OpenStax CNX, Merlot, and the American Institute of Mathematics' Open Textbook Initiative, we recently found that no such textbook completely encompasses the learning objectives outlined by our department and the University System of Georgia. As a result, we shall create a text that adheres to the guidelines set forth by our department. Currently, such a course calls for between 70% and 90% of the material to come from sets and set operations, logic, basic probability, data analysis, and modeling from data. We shall create a textbook that not only adopts these measures as a central focus, but also embeds videos into the text so students with a visual and auditory learning style can see how the aforementioned topics are incorporated into problem solving. The videos mentioned above shall be recorded using Camtasia Studio 8 along with a wide array of mathematical software (including Mathematica, Sage, Beamer (LaTeX), etc.) and shall also be uploaded to YouTube in order to provide accessibility across multiple platforms.

Alongside the aforementioned material, there exists at most 15% of class time dedicated to review and up to 20% of class time given for special topics such as mathematics and the arts, mathematics and politics, mathematics and business, and mathematics and finance. The review material shall be created in the same vein as the uniform requirements for the course

where we shall equally divide creation of the textbook's written and video portion. However, the difference shall lie when Dr. Brown creates all of the content coinciding with mathematics and the arts and mathematics and politics, while Dr. Lambert shall focus his efforts on mathematics and business and mathematics of finance.

With academic freedom a valued practice at our institution, the provided material will be made available along with the associated TeX file, allowing instructors to include, exclude, or reorder the material in order to fit the needs of the individual. This freedom of design allows for those choosing to emphasize those different parts in the optional topics to adopt the text while making it fit the needs of their own classroom.

Upon completion of the text, we shall use the free online homework system WebWork to create a series of homework sets that coincide with the learning objectives outlined for the course. With several other instructors within the department currently teaching Quantitative Skills and Reasoning, we expect to help them implement WebWork if they so desire.

Quantitative & Qualitative Measures: With this core course stemming from the mathematics department, measuring the quantitative impact can be easily gathered and compared to previous data collection from our department for the DFW rate, final course grades, and the Quantitative Skills and Reasoning Basic Skills Exam (this assessment was created and used by our department to measure the student learning outcomes in Quantitative Skills and Reasoning). The comparisons between these sets of data shall be made using demographic data such as race, gender, traditional/non-traditional, along with a series of other quantitative data obtained prior to admittance into the institution. Our expectations coincide with an improvement in all of the aforementioned quantitative metrics, but in a worst-case scenario we would want the open-source text to result in similar results to that prior to the texts implementation.

In terms of the qualitative impact that the open-source resources have on our students, we shall seek student feedback on a variety of questions. A small sample of the questions included will be
1. Are you satisfied with the quality of the textbook for this course?
2. If implemented, are you satisfied with the quality of the online homework system for this course?
3. Are you satisfied with the quality of the videos associated with the text?
4. Do you think the text distracted from your ability to learn the required material for the course?

Alongside these aforementioned measures, we will compare the university faculty and course evaluation survey before and after the adoption of the text.

While collecting the data from students along with feedback from other faculty members, we shall listen to their needs to decide if further edits to the text will be required.

Timeline:

January 2016 - Create text for Sets and Set Operations section.

February 2016 - Create text for Logic section.

March 2016 - Create text for Basic Probability section.

April 2016 - Create text for Data Analysis section.

May 2016 - Create text for Modeling from Data section.

June 2016 - Create text for review materials.

July 2016 - Create text for optional topics.

August 2016 - Create videos for Sets and Set Operations, Logic, Basic Probability, Data Analysis, and Modeling from Data sections and incorporate those videos into the text.

September 2016 - Create videos for the review materials and optional topics sections and incorporate those videos into the text.

October 2016 - Create homework sets associated with the uniform requirements into WebWork.

November 2016 - Create homework sets associated with the review and optional topics into WebWork.

December 2016 - Submission of final report.

Spring 2017 - Implement the new text and collect data from the classes.

Budget:

The budget for this proposal is $10,800. We are requesting $10,000 for release time for Dr. Brown and Dr. Lambert. Each professor would receive two course releases in the Fall of 2016, each costing $2,500 per course per professor (amounting to the total cost of $10,000). We also request $800 for registration and travel expenses for professors Dr. Brown and Dr. Lambert. That amount would be split evenly with $400 for each professor to cover expenses to attend conferences or workshops that either provide a forum for presenting the results of our open-source textbook project or include programming and training directly related to the creation or implementation of our open-source textbook.

Sustainability Plan:

The adoption of the open-source text will begin in Spring 2017 for all sections of Quantitative Skills and Reasoning. During the first and subsequent semesters in which the new text is used, other members of the department will be asked for feedback and suggestions for modifications to the text. One of the advantages to an open-source textbook is that these corrections can be implemented immediately. As the textbook continues to be used we will

also continue to seek input from the mathematics faculty and make changes as necessary. As this textbook will be interactive, we will annually check links and embedded files to be sure the quality is maintained. A similar process will occur with the online homework. Finally, as the qualitative and quantitative assessments show success, we will promote the textbook for use by other University System of Georgia institutions teaching the same core course.

Office of the Provost
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912.344.2589 | Fax 912.344.3492 | armstrong.edu

December 13, 2015

To whom it may concern,

The Office of Student Engagement and Success in Academic Affairs, wholeheartedly supports the proposal, by Drs. Brown and Lambert from the Department of Mathematics, to develop an open textbook and online homework for our calculus sequence. Funding this project will result in huge cost savings for our over 500 MATH 1001 students each year. This proposed project will have a high impact on students pursuing health professions and education degrees as those are the students who make up the majority in the Quantitative Skills and Reasoning courses. The Department faculty are interested in replacing the current text as it is not completely matched to the course content and the cost of the text and the online homework are high. The project directors will work to develop new materials for this course, as opposed to adapting other materials, due to the unique content in the course and the needs of the non-major audience. The two faculty involved in this project have a history of concern and commitment to improved student learning through their involvement in high impact pedagogy and professional development.

Armstrong is committed to the success and retention of our students. The Provost's office will assist this trailblazing campus team in any way possible and will work with the Department of Mathematics, as well as the rest of the campus, to broaden the university's adoption of open source materials wherever available. It is hoped that this team will develop a campus model that will assist other faculty and departments in their quest to develop open source material, leading to broader sustainability of the open textbook concept at Armstrong.
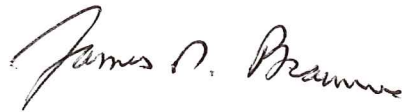
Thank you for your consideration of this proposal,

Dr. Delana A. Gajdosik-Nivens
Professor of Chemistry
Associate Provost for Student Engagement and Success
Armstrong ALG Champion

Armstrong
STATE UNIVERSITY

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December 14, 2015

Drs. Tricia Brown and Joshua Lambert have written a proposal for a textbook transformation grant. In their proposal they will create an open-source multimedia textbook and accompanying online homework system for our Quantitative Reasoning course (MATH 1001). The text and homework system will be aligned with our student learning objectives and will be available to students at no cost. This will provide a tremendous benefit to our students, who often have to pay over $200 for a text and the accompanying online homework system. In addition to easing the financial burden of our students, the open-source text can be fine-tuned after its initial run to meet any changes in the desired learning outcomes, and will be assessed to measure student improvement in Quantitative Reasoning. I heartily endorse this textbook transformation project.

James N. Brawner, Ph.D.
Professor and Head of Mathematics
Armstrong State University

Syllabus

Course Outline for MATH 1001 (Option A) -- Quantitative Skills and Reasoning - May 2017

Text: Math in Society, David Lippman

Module 1: There's More to Math than Numbers
1. Submodule: Logic
   a. Read the Introduction to Logic file.
   b. Read The Negation of a Statement file.
   c. Read the Conjunction and Disjunction file.
   d. Read The Implication file.
   e. Read the Converse, Inverse, and Contrapositive Statements file.
   f. Watch the YouTube video titled Symbolic Logic by Glen Gray.
   g. Participate in the Conditional Propositions Discussion (Optional).
   h. Participate in the Logic Discussion.
   i. Complete the Logic Quiz.
2. Submodule: Set Theory
   a. Watch the Sets and Subsets pencast.
   b. Read pages 319-328 from your textbook.
   c. Watch the Venn Diagrams pencast.
   d. Watch the Khan Academy video titled "Intersection and Union of Sets."
   e. Read the Disjoint Sets file.
   f. Participate in the Set Theory Discussion.
   g. Complete the Set Theory Quiz.
3. Submodule: Critical Thinking
   a. Watch the Types of Arguments pencast.
   b. Watch the YouTube video titled "An Introduction to Critical Thinking" by Aaron Dewald.
   c. Participate in the Phone Plan Discussion (Optional).
   d. Participate in the Critical Thinking Discussion.
   e. Complete the Critical Thinking Quiz.

Module 2: Problem Solving Strategies
1. Submodule: Conversions
   a. Watch the Units of Measurement pencast.
   b. Watch the YouTube video titled "The Basic Units of Measurement" by Chemistry with Mrs. K.
   c. Watch the Khan Academy video titled "U.S. Customary and Metric Units Video."
   d. Watch the Khan Academy video titled "Finding Reasonable Unit of Measurements Video."
   e. Watch the Addition and Multiplication of Fractions pencast.
   f. Watch the YouTube video titled "How To Convert Units - Unit Conversion Made Easy" by Greg Schwanbeck.
   g. Watch the Khan Academy video titled "Converting Within the Metric System."
   h. Watch the Khan Academy video titled "Conversions Between Metric Units."
   i. Watch the YouTube video titled "Unit Conversions in the Metric System" by Sciencepost.
   j. Watch the Khan Academy video titled "Performing Arithmetic Calculations on Units of Volume."
   k. Watch the YouTube video titled "Customary Units of Measurement" by Michele Hearn.
   l. Participate in the Conversions Discussion.
   m. Complete the Conversions Quiz.
2. Submodule: Problem Solving
   a. Watch the Working with Units pencast.

b. Watch the Khan Academy video titled "Unit Measurement Word Problem: Running Laps (U.S. Customary)."
c. Watch the Problem Solving pencast.
d. Watch the Khan Academy video titled "Solving Application Problems Involving Units of Volume."
e. Watch the Khan Academy video titled "Application Problems Involving Units of Weight."
f. Read pages 6-16 from your textbook.
g. Watch the Khan Academy video titled "Unit Conversion Word Problem: Drug Dosage."
h. Participate in the Stock Discussion (Optional).
i. Participate in the Problem Solving Discussion.
j. Complete the Problem Solving Quiz.
k. Complete Exam 1 which covers material from the There's More to Math than Numbers and Problem Solving modules.

Module 3: Using Numbers in the Real World
1. Submodule 1: Percentages
a. Watch the YouTube video titled "Finding a Percent of a Number" by Math Antics.
b. Watch the YouTube video titled "What Percent Is It" by Math Antics.
c. Watch the YouTube video titled "Percents Missing Total" by Math Antics.
d. Watch the "Percentages" pencast.
e. Read pages 120-131 from your textbook.
f. Participate in the Receipts Discussion (Optional).
g. Participate in the Dividends Discussion (Optional).
h. Participate in the Percentages Discussion (Mandatory).
i. Complete the Percentages Quiz.

2. Submodule 2: Taxes
a. Read from page 254 through Example 2 on page 256 from your textbook.
b. Watch the YouTube video titled "How Income Tax Brackets Work" by yourtwobits.
c. Read the Income Tax Computations file.
d. Participate in the Taxes Discussion.
e. Complete the Taxes Quiz.

3. Submodule 3: Number Sense
a. Watch the YouTube video titled "Scientific Notation (Math Song)" by Mr Colin Dodds.
b. Watch the YouTube video titled "Solve Problems Involving Scientific Notation" by NEA Portal.
c. Watch the YouTube video titled "A Clever Way to Estimate Enormous Numbers" by Ted-Ed.
d. Participate in the Estimating Windows Discussion.
e. Watch the Khan Academy video titled "Significant Figures."
f. Watch the Khan Academy video titled "More on Significant Figures."
g. Watch the YouTube video titled "Precision, Accuracy, Measurement, and Significant Figures" by Michael Farabaugh.
h. Watch the Putting Numbers into Perspective pencast.
i. Participate in the Manipulating Numbers Discussion (Optional).
j. Participate in the Number Sense Discussion (Mandatory).
k. Complete the Number Sense Quiz.

Module 4: Financial Planning
1. Submodule 1: Investing 1001
a. Watch the "Finances" pencast.
b. Watch the "Compound Interest Formula" pencast.
c. Watch the YouTube video titled "Compound Interest Example - Finding Starting Principal" by Patrick JMT.
d. Watch the "Compounded Continuously" pencast.

e. Watch the "Savings Plan Formula" pencast.
f. Read pages 197-208 from the textbook.
g. Participate in the How To Become a Millionaire Discussion (Optional).
h. Watch the "Total and Annual Return" pencast.
i. Participate in the Investing 1001 Discussion (Mandatory).
j. Complete the Investing 1001 Quiz.

2. Submodule 2: Loans
a. Watch the Loan Payment pencast.
b. Watch the Mortgages pencast.
c. Read pages 211-217 from the textbook.
d. Participate in the 15 vs. 30 Year Mortgage Discussion (Optional).
e. Participate in the Loans Discussion (Mandatory).
f. Complete the Loans Quiz.

3. Submodule 3: Index Numbers
a. Watch the YouTube video titled "Index Number" by INEDifusion.
b. Watch the YouTube video titled "Macro Episode 16: Inflation & Price Indexes" by Mjmfoodie.
c. Participate in the Top Grossing Movies Discussion (Optional).
d. Read the Index Numbers file.
e. Watch the Housing Price Index video.
f. Participate in the Index Numbers Discussion (Mandatory).
g. Complete the Index Numbers Quiz.
h. Complete Exam 2 which covers Module 3: Using Numbers in the Real World and Module 4: Financial Planning.

Module 5: The Fundamentals of Statistics

1. Lies, Damned Lies, and Statistics
a. Watch the YouTube video titled "How Statistics Can Lie by Nathan Leslie.
b. Watch the TEDx Talk titled "Show Me the Data -- Becoming an Expert in Yourself" by Talithia Williams.
c. Watch the Introduction to Statistics video.
d. Watch the YouTube video titled "Cumulative Frequency" by Maths4Everyone.
e. Watch the YouTube video titled "Statistics - How to Make a Cumulative Frequency Distribution" by My Secret Math Tutor.
f. Participate in the Frequency, Relative Frequency, and Cumulative Relative Frequency Discussion (Optional).
g. Participate in the Lies, Damned Lies, and Statistics Discussion (Mandatory).
h. Complete the Lies, Damned Lies, and Statistics Quiz.

2. Graphing Data
a. Watch the YouTube video titled "Basic Graph Types: Lesson" by the CK-12 Foundation.
b. Watch the YouTube video titled "A Beginner's Guide to Graphing Data" by Bozeman Science.
c. Watch the Pie Charts vs. Bar Graphs Pencast.
d. Watch the YouTube video titled "Bar Graphs: Lesson" by the CK-12 Foundation.
e. Watch the YouTube video titled "Histogram Explained" by Cylurian.
f. Watch the YouTube video titled "How to Make a Stem & Leaf Plot" by eHow.
g. Participate in the Displaying Data Discussion (Optional).
h. Participate in the Graphing Data Discussion (Mandatory).
i. Complete the Graphing Data Quiz.

3. Correlation vs. Causality
a. Watch the YouTube video titled "Statistics: Correlation vs. Causation by StatisticsLectures.com.
b. Watch the YouTube video titled "Scatter Plots: Introduction to Positive and Negative Correlation" by Rodcastmath.

    c.   Watch the Correlation vs. Causality clip from the movie Freakonomics.

    d.   Watch the Correlation vs. Causation video.

    e.   Watch the TEDx Talk by Ionica Smeets titled "The Danger of Mixing Up Causality and Correlation."

    f.   Read the 10 Times Correlation was not Causation article.

    g.   Participate in the Correlation vs. Causation Discussion (Optional).

    h.   Participate in the Correlation vs. Causality Discussion (Mandatory).

    i.   Complete the Correlation vs. Causality Quiz.

Module 6: Statistics in the Real World

1. Mean, Median, and Mode

    a.   Watch the Khan Academy video titled "Statistics Intro: Mean, Median, and Mode."

    b.   Watch the Khan Academy video titled "Finding Mean, Median, and Mode."

    c.   Watch the YouTube video titled "Skewed Histograms" by Cylurian.

    d.   Participate in the Symmetric and Skewed Distribution Discussion (Optional).

    e.   Participate in the Mean, Median, and Mode Discussion (Mandatory).

    f.   Complete the Mean, Median, and Mode Quiz.

2. Variation

    a.   Watch the Percentiles video.

    b.   Watch the Quartiles video.

    c.   Watch the Khan Academy video titled "Box-and-Whisker Plot."

    d.   Watch the Khan Academy video titled "Box-and-Whisker Plots."

    e.   Watch the Boxplot video.

    f.   Watch the Standard Deviation video.

    g.   Watch the Khan Academy video titled "Range, Variance, and Standard Deviation as Measures of Dispersion."

    h.   Participate in the Standard Deviation Discussion (Optional).

    i.   Participate in the Variation Discussion (Mandatory)

    j.   Complete the Variations Quiz.

3. Normal Distribution

    a.   Watch the "Normal Distributions" pencast.

    b.   Watch the Khan Academy video titled "ck12.org Normal Distribution Problems: Qualitative Sense of Normal Distribution."

    c.   Watch the Khan Academy video titled "ck12.org Normal Distribution Problems: z-Score."

    d.   Watch the Khan Academy video titled "ck12.org Normal Distribution Problems: Empirical Rule."

    e.   Watch the Khan Academy video titled "ck12.org Exercise: Standard Normal Distribution and the Empirical."

    f.   Watch the Khan Academy video titled "ck12.org: More Empirical Rule and z-Score Practice."

    g.   Participate in the Normal Distribution Example Discussion (Optional).

    h.   Print off a copy of the Normal Distribution Table.

    i.   Watch the YouTube video titled "Normal Distributions & z-scores" by pspollard 1's channel.

    j.   Watch the following YouTube video titled "Normal Distribution: Finding z and x-Reverse Lookup" by Joshua Emmanuel.

    k.   Participate in the Normal Distribution Discussion (Mandatory).

    l.   Complete the Normal Distribution Quiz.

    m.   Complete Exam 3 which covers Module 5: The Fundamentals of Statistics and Module 6: Statistics in the Real World.

Module 7: The Basics of Probability

1. Permutations and Combinations

    a.   Watch "The Addition Principle" pencast.

    b.   Watch "The Multiplication Principle" pencast.

    c.   Watch the "Permutations and Combinations" pencast.

      d. Watch the "[Combination and Permutation Examples](#)" pencast.

      e. Read pages 293-300 from the [textbook](#).

      f. Participate in the Permutation and Combination Song Discussion (Optional).

      g. Participate in the Permutations and Combinations Discussion (Mandatory).

      h. Complete the Permutations and Combinations Quiz.

2. Introduction to Probability
   a. Watch the [Finite Probability](#) pencast.
   b. Watch the YouTube video titled "Probability - Part One: Simple Probability" by Kolumath.
   c. Watch the YouTube video titled "Probability - Part Two: Compound Probability" by Kolumath.
   d. Watch the YouTube video titled "Basic Rules of Probability and Examples."
   e. Read pages 279-292 and 301-309 from the [textbook](#).
   f. Participate in the Rolling Two Dice Discussion (Optional).
   g. Participate in the Introduction to Probability Discussion (Mandatory).
   h. Complete the Introduction to Probability Quiz.

Module 8: Types of Growth

1. Linear Growth
   a. Watch the "[Linear Growth](#)" pencast.
   b. Read the pages 173-178 from the [textbook](#).
   c. Participate in the Linear Growth Examples Discussion (Optional).
   d. Participate in the Linear Growth Discussion (Mandatory).
   e. Complete the Linear Growth Quiz.

2. Exponential Growth
   a. Read the pages 178-188 in your [textbook](#).
   b. Participate in the Linear vs. Exponential Growth Discussion (Optional).
   c. Participate in the Exponential Growth Discussion (Mandatory).
   d. Complete the Exponential Growth Quiz.
   e. Complete Exam 4 which covers the modules titled Module 7: The Basics of Probability and Module 8: Types of Growth.

Module 9: [Voting Theory](#)*

1. Preference Schedules
2. Plurality and the Condorcet Criterion
3. Instant Runoff and the Monotonicity Criterion
4. Borda Count and the Majority Criterion
5. Pairwise Comparisons and the Independence of Irrelevant Alternatives Criterion
6. Arrow's Impossibility Theorem
7. Approval Voting

Module 10: [Graph Theory](#)*

1. Basic Definitions
2. Shortest Path
   a. Dijkstra's Algorithm
3. Euler Circuits and the Chinese Postman Problem
   a. Fluery's Algorithm
   b. Eulerization
4. Hamilton Circuits and the Travelling Salesman Problem
   a. Nearest Neighbor Algorithm (NNA)

        b. Repeated Nearest Neighbor Algorithm (RNNA)
        c. Sorted Edges Algorithm
5. Spanning Trees
        a. Kruskal's Algorithm

*Items are optional chapters used in the face-to-face, Option B version of the course and may be used in place of Modules 1 or 4.

Course Outline for MATH 1001 (Option B) - Quantitative Skills and Reasoning - May 2017

Text: Math and Society, David Lippman, `http://www.opentextbookstore.com/mathinsociety/`

Learning Management System: MyOpenMath, `http://www.myopenmath.com`

Given below are the concepts and associated chapters to be covered in MATH 1001. Starred topics are optional material that may be replaced with any other optional chapter of the text.

I. Ch 1: Problem Solving

    (a) Percentages

    (b) Absolute and relative change

    (c) Conversions

    (d) Problem solving

II. Ch. 2: Graph Theory*

    (a) Shortest path

    (b) Euler circuites

    (c) Hamilton circuits

    (d) Spanning Trees

III. Ch. 3: Voting Theory*

    (a) Ranked preference voting methods including plurality, runoff, pairwise comparisons, and Borda count

    (b) Approval voting

    (c) Fairness criteria and Arrow's Impossibility Theorem

IV. Ch. 4: Growth Models

    (a) Linear

    (b) Exponential

    (c) Logistic

V. Ch. 5: Financial Mathematics*

    (a) Simple and compound interest

    (b) Annuities

    (c) Loans

VI. Ch. 6: Statistics - Collecting Data

    (a) Polling Methods

    (b) Sources of bias

    (c) Experimental design

VII. Ch. 7: Statistics - Describing Data

    (a) Displays for qualitative variables

    (b) Displays for quantitative variables

    (c) Measures of center and variation for quantitative variables

VIII. Ch. 8: Probability

    (a) Compound probability

    (b) Conditional probability

    (c) Bayes' Theorem

    (d) Expected Value

Additional optional chapters: Weighted Voting, Apportionment, Fair Division, Scheduling, Sets, Counting Systems, Fractals, Cryptography

Non-optional material	20-25 hours
Optional material	12-15 hours
Testing	4-8 hours
Total	45 hours

Each chapter should take 4-5 50 minutes class meetings or 3-4 75 minute class meetings. Instructors may choose to offer 4 midterm exams (every two chapters) or 8 midterm exams (associated with each chapter). A cumulative final exam is recommended. An example of such a schedule from Spring 2017 is given on the next page.

Schedule – Spring 2017

Problem Solving	Chapter 1	Jan 9, 11, 13, 18
	Quiz	Jan 20
MLK	No class	Jan 16
Voting Theory	Chapter 2	Jan 23, 25, 27, 30
	Quiz	Feb 1
Graph Theory	Chapter 3	Feb 3, 6, 8, 10, 13
	Quiz	Feb 15
Growth Models	Chapter 4	Feb 17, 20, 22, 24, 27
	Quiz	Mar 1
Finance	Chapter 5	Mar 3, 6, 8, 10
	Quiz	Mar 20
Spring Break	No class	Mar 13 – 17
Statistics - Collecting Data	Chapter 6	Mar 22, 24, 27, 29
	Quiz	Mar 31
Statistics - Describing Data	Chapter 7	Apr 3, 5, 7, 10, 12
	Quiz	Apr 14
Probability	Chapter 8	Apr 17, 19, 21, 24, 26
	Quiz	Apr 28

Final Report

Affordable Learning Georgia Textbook Transformation Grants

Final Report

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Grant Number: 210

Institution Name(s): Armstrong State University

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Course Name(s) and Course Numbers: Quantitative Skills and Reasoning, Math 1001

Semester Project Began: Spring 2016

Semester(s) of Implementation: Fall 2016, Spring 2017

Average Number of Students Per Course Section: 20

Number of Course Sections Affected by Implementation: 4

Total Number of Students Affected by Implementation: 81

1. Narrative

As stated in our proposal, the goal of this project was "to create and adopt an open-source, multimedia textbook and online homework system for the mathematics core course, Quantitative Skills and Reasoning." We wished "to engage students, alleviate financial burden, and promote academic success." To begin, the open source book, *Math in Society* by David Lippman was chosen to be the text at the basis of the project. The content of this book fits well with the learning outcomes put forth by the University System of Georgia as well as the needs of our own institution. Throughout this project we worked on two versions of this course, a fully online course incorporated in D2L and a traditional face-to-face course accompanied by the MyOpenMath learning management system. Both of these LMS are available to the students at no extra cost. We piloted the face-to-face course first with two sections in Fall 2016. This first adaptation was a success, though not without challenges. Previously, our institution had been using a textbook and LMS offered through one of the big publishers. Students would have an e-book and online homework, and instructors would have access to a powerful LMS as well as teaching materials such as activities and lecture slides. Switching to MyOpenMath did require some adjustment. The number of exercises was not as plentiful, the LMS was not quite as powerful, and the

accompanying teaching materials were limited. Thus, an aim for this project was also to smooth this transition for other instructors. We developed lecture slides and additional videos, as well as provided a LaTeX version of the book for flexibility and collected and created homework exercises for those instructors who wish to use WebWork instead of MyOpenMath. The implementation in a fully-online section of the course followed in Spring 2017. Videos and pencasts were collected and created to introduce and illustrate the topics of the new textbook. Student comments suggest these were very successful when utilized in the online course as a replacement for face-to-face lectures.

In terms of the impact on our instruction, we saw little change with the new material. With the development of additional supplementary materials, both team members were able to continue to teach in a similar style to that which we used before the new course materials were adopted. That is itself, is a success for the project. One of the fears for faculty about adopting new material is the amount of changes that they will have to make. We feel this adoption should be fairly straight-forward for future instructors. One other small impact on instruction, was due to the fact that the newly adopted material is presented in friendlier and more interesting manner than the previous material. As an instructor, being more interested in the material yourself can certainly be apparent to the students and allow for a more effective and compelling presentation of the material. Finally, the development of the LaTeX version of the book will allow us and other instructors greater flexibility in creating assignments and slides to accompany the book. LaTeX is a typesetting language used primarily by mathematicians and physicists. It is significantly easier to use than word-processing programs like Microsoft Word for mathematical content. Without a LaTeX version of the book, instructors who wish to pull definitions, graphical examples, or problems from the text to a worksheet or slide would have to spend time reformatting the material. Having the content already formatted will allow greater flexibility to create additional materials quickly as well as the freedom to easily rearrange the book to suit the needs of their classroom and instructional style.

The implementation had a direct and strong impact on the students. Although our pilot test was small, 84 students saved at minimum $127.50 by not having to purchase the textbook and online homework system. The course materials were well-received by the students; none of them disliked the materials more than those associated with other courses and 89% of them were positive about the implementation. The department will fully adopt the materials beginning in the upcoming fall semester, so the financial costs will be alleviated for an increasing number of students. Further, student performance also improved. DFW rates fell slightly from previous semesters, students showed improvement in five of six learning objectives, and class grade point averages increased. While each of these gains were small and we cannot conclude significant improvement, we can say that using the new course materials did not negatively impact the students. Our final goal of student engagement is difficult to measure as many aspects of teaching and learning contribute to engagement in addition to the course materials. However, course evaluations indicated that 89% (32 of 36) of the students felt they learned more than usual in this

course while using the new materials compared with 62% (29 of 47) from previous semesters. This suggests the student perception was that they had a greater understanding and more involvement with the course content.

At the conclusion of this project, we can reflect on things we could have done differently. First and most importantly, we were fairly far off on the scope of this project. Starting 18 months ago, we felt that we would be able to almost "start from scratch" and create a new textbook that perfectly suited our needs. This goal was too lofty. It quickly became apparent that there was high-quality, open-source content and exposition already available and it was not necessary for us to independently reinvent this material. We should have spent less time at the beginning planning a new book, and more time tailoring existing material to our needs and developing supplemental materials. We may have been ready for a full Spring 2017 implementation if we had spent time differently in the beginning. Apart from this, the development proceeded as planned. The necessary course materials including the textbook, online homework exercises, multimedia resources, and lecture slides, have been created, collected, and made available for the departmental adoption next fall.

2. **Quotes**

- I am satisfied with the course. I liked that the textbook was online so we didn't need to purchase it or carry around a heavy book. The online quizzes were very helpful. I found that they helped me practice the material and figure out what I knew and what I didn't know. The videos were generally very helpful. I especially liked the pencasts.
- I was very satisfied with the textbook. Not only was it open source, and free, it had a lot of helpful information. It also helped me organize all the equations that I would need to use for the quizzes and tests. The online quizzes were really helpful in helping me understand the material better, and also helping me prepare for the exams. The videos helped present some of the more difficult material in different ways. The pencasts were helpful, and even though there was some difficulty in the service, it was promptly fixed.
- I didn't use the online textbook very much, but when I did use it, it was -mostly- helpful. It confused me a couple of times, but on the whole it provided examples that helped explain things and allowed me to learn math how *I* do, which involves a lot of reverse-engineering. I liked the fact that I knew what to expect. 10 questions for module quizzes, 20 for tests. The only thing I would change is that I personally would've liked a few more multiple choice questions in the modules towards the end, but I understand where short-answer questions might have been more helpful. However, I would've liked to know how to format my answers. On many occasions, I missed up to 20 points on *tests* because I didn't know if I should put something as a decimal or percentage. The videos were informative and helped cover the basics of

what I needed to know to understand the module. The pencasts were EXTREMELY helpful as well. It was nice to have these two resources (as the videos mostly had captions available or had text on there to begin with) that had things written out that I could re-word and put into my notes.

- I was satisfied by the quality of the textbook course. I liked not having to really use the textbook, but had easy access to it, which was nice and convenient. I am extremely satisfied with the quality of online quizzes for this course. It was great for my grades to be able to retake quizzes over and over until I got the best score possible. Having the ability to take quizzes over was also helpful when studying for tests and finals. You are able to refresh your memory and make sure you still have each module down. Other than the few pen-casts that did not work right away, I am overall satisfied with the quality of the videos. It was somewhat difficult to skip to certain parts on pen-casts however.

- I was satisfied with the quality of the textbook because it shows multiple step by step examples for different topics and all the more that it was free and open to the public. I am not all that satisfied with the online quizzes in D2L it may have a glitch because a few times I would complete a quiz and a question on my 1st attempt would be right and the next attempt on the same question says I answered it wrong. The videos sometimes are enough to help me with the topics but sometimes I need further assistance and that is when the mandatory discussion is very helpful.

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?

Total number of students affected in this project: 81

- Positive: __89__ % of __47__ number of respondents
- Neutral: __11__ % of __47__ number of respondents
- Negative: __0__ % of __47__ 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:
- __X__   Positive: Higher performance outcomes measured over previous semester(s)
- ___   Neutral: Same performance outcomes over previous semester(s)

- ___ Negative: Lower performance outcomes over previous semester(s)

Student Drop/Fail/Withdraw (DFW) Rates

Was the overall comparative impact on Drop/Fail/Withdraw (DFW) rates in the semester(s) of implementation over previous semesters positive, neutral, or negative?

Drop/Fail/Withdraw Rate:

24.7% of students, out of a total 81 students affected, dropped/failed/withdrew from the course in the final semester of implementation.

Choose One:

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

3b. Narrative

In terms of impact of the new materials, we anticipated the major impact factor to be in terms of no cost and there would be little change (if any) in terms of student success rates for the course. Although the sample size is too small to indicate any significant changes thus far, the initial measurements indicate a slight improvement to student outcomes when implementing these new materials. We shall list the data in multiple formats below.

We begin by viewing the DFW rates before and after the textbook transformations. When viewing across both professors implementing these new materials, we saw an improvement in the DFW rate from 37.5% for 176 students before using the new textbook to 24.7% for 81 students when implementing the new textbook. While this indicates a positive trend, viewing the DFW rate by each professor's implementation indicates another story. The DFW rate for Dr. Brown increased from 14% for 66 students prior to the textbook transformation to 19% for 63 students after the textbook transformation. Meanwhile, Dr. Lambert saw his DFW rate fall slightly from 51.8% for 110 students prior to using the new textbook to 44% for 18 students (which is too small of a sample size to demonstrate any significant results) after using the new textbook. Overall, there is insufficient information to make any claims about improvements or setbacks with the DFW rate.

With Quantitative Skills and Reasoning allowing professors the academic freedom to choose from a series of optional materials, each class has unique features when comparing different professors. However, there are six learning objectives that appears across all classes and provided us with an opportunity to collect data. We shall begin with Learning Objective 1 (LO1), which states "Students can develop strategies for solving quantitative problems." For

this learning objective, we saw student understanding increase from 68.53% for 153 students prior to the textbook transformation to 73.16% for the 80 students using the new textbook and materials for the course. Similar improvements occurred with each professor involved with the textbook transition.

Our second and third learning objective (LO2 and LO3) are given by "Students can express numbers in a variety of ways (such as decimals, fractions, percentages, and scientific notation)" and "Students can interpret the uses and abuses of percentages in the real world (such as taxes, tips, inflation, stock dividends, salary increases, etc.)", respectively. These learning objectives saw similar improvements for both professors and a combined increase in student comprehension from 65.43% for 147 students prior to the new book to 72.88% for 79 students after students used the new book.

The progressive trend continues for learning objectives 4 and 5 (LO4 and LO5), which state "Students can infer key characteristics of a data set given statistics represented graphically" and "Students can interpret key characteristics of a variable given data sets and descriptive statistics", respectively. For the group of 141 students using the previous set of materials, 66.06% demonstrated comprehension of these learning objectives. Meanwhile, the 73 students using the new textbook and materials saw an 81.73% comprehension rate of these learning objectives. Similar results occurred for all the instructors implementing the new textbook and materials.

While a majority of the learning objectives saw improvements, learning objective 6 (LO6) saw a decrease in student comprehension. This learning objective states "Students can design mathematical models reflecting real-world phenomena." For this learning objective, we saw a slight decrease in student comprehension from 66.91% for 136 students prior to the book implementation to 64.99% for 72 students that saw the new textbook and materials. Overall, this gave us a slight improvement on 5 of the 6 common learning objectives for the course.

Another measure used across all professor's classes is the grade point average (GPA) for the course. With this measure, we began with an average GPA for the course of 2.05 prior to our work with the new textbook. After implementing the new textbook and materials, the average GPA rose to 2.48 for all of the courses. The viewpoint of this data can tell a different story if we look at each professor's average GPA. Prior to the new material implementation, Dr. Brown's classes had an average GPA of 2.74. When comparing this to the average GPA of 2.67 after using the new textbook, we notice a slight difference. For Dr. Lambert's classes, we saw the average GPA rise from 1.56 to 1.82 as the new textbook became implemented.

The final measure we viewed after implementing the new textbook is the students' opinions of the course and materials. Although previous studies demonstrate that such opinions do not provide much insight into overall class comprehension, we noticed an overwhelming majority (89% of the 47 people that submitted a survey) provided positive feedback. As we anticipated, the students mentioned an appreciation for the materials being

open source. This appreciation remained consistent across all courses involved in the survey.

As previously mentioned, these numbers indicate progress with the course textbook and materials, but the sample size for our observations is too small to make any claims for the whole university. This leads us to one of the factors that led to such a small sample size for the implementation. Before the spring semester began, the faculty at Armstrong State University learned that our institution will be consolidating with Georgia Southern University. With many of our own faculty being called upon to help form this consolidated institution, we decided to delay the transition of the new textbook to all of the mathematics department faculty until we were assured that this course would exist in the new institution. Upon receiving word in April that the newly formed mathematics department plans to operate such a class, more faculty plan to implement the new textbook in the fall semester. This should remedy our problem of having a small sample size and allow us to truly measure the overall performance of the new textbook and materials.

4. Sustainability Plan

Our department plans to fully utilize the open-source course materials for all MATH 1001 courses beginning in Fall 2017. Currently, these course materials are available on Desire2Learn (D2L) for Armstrong State University faculty and our faculty webpages, http://math.armstrong.edu/faculty/lambert/QuantitativeSkillsAndReasoningWebpage.html and www.math.armstrong.edu/faculty/brown/MATH1001.html. These pages include links to the textbook and online homework as well as videos, pencasts, slides, and activities to accompany the text. Further, the online course in D2L and the face-to-face course which has been set up in MyOpenMath will be available to be copied by faculty wishing to obtain all the materials at once. The team members will continue to monitor the stability of these pages and update them as necessary.

5. Future Plans

The first thing this project has demonstrated is that there is a lot of open-source material available. Before beginning the project, there was a feeling that open-source material was limited and of poor-quality. After working to compile the resources for this project, we realize that this is not the case. In the future, we will be much more likely to explore the open-source resources in order to avoid unnecessary costs for the students.

Besides lower cost, open-source materials allow for much greater instructor flexibility. As instructors, open-source material allows us to choose chapters from many different books or resources, choosing the presentations of the content that most suit our courses. We can offer different viewpoints and modes of explanation to help struggling students understand difficult concepts. There is a much greater chance we will use additional open-source material to supplement the main text in the future.

We expect to present the results of the project to the department in at the start of the

next school year. At this point, no publications are planned.

6. Description of Photograph

To be uploaded in the future.