

Spring 2018

Differential Equations (FVSU)

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Grants Collection

Fort Valley State University



UNIVERSITY SYSTEM
OF GEORGIA

Samuel Cartwright, Bhavana Burell, Patcharin Marion,
and Jianmin Zhu

Differential Equations





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.



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Initial Proposal

Application Details

Manage Application: ALG Textbook Transformation Grants

Award Cycle: Round 6

Internal Submission Deadline: Monday, August 1, 2016

Application Title: 246

Application ID: #001140

Submitter First Name: Samuel

Submitter Last Name: Cartwright

Submitter Title: Associate Professor

Submitter Email Address: cartwris@fvsu.edu

Submitter Phone Number: (478) 825 6997

Submitter Campus Role: Proposal Investigator (Primary or additional)

Applicant First Name: Samuel

Applicant Last Name: Cartwright

Applicant Email Address: cartwris@fvsu.edu

Applicant Phone Number: 4788256997

Primary Appointment Title: Associate Professor of Mathematics

Institution Name(s): Fort Valley State University

Submission Date: Monday, August 1, 2016

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

Dr. Patcharin T. Marion, Associate Professor of Mathematics, Department of Mathematics and Computer Science, Fort Valley State University, tragoonsirisakp@fvsu.edu

Ms. Bhavana Burell, Lecturer of Mathematics and Computer Science, Department of Mathematics and Computer Science, Fort Valley State University, burellb@fvsu.edu

Dr. Jianmin Zhu, Professor of Mathematics, Department of Mathematics and Computer Science, Fort Valley State University, zhuj@fvsu.edu

Dr. Samuel Cartwright, Associate Professor of Mathematics, Department of Mathematics and Computer Science, Fort Valley State University, cartwris@fvsu.edu

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

Dr. Dawit Aberra, Ph.D., Department Chair, The Department of Mathematics and Computer Science, Fort Valley State University

Proposal Title: 246

Course Names, Course Numbers and Semesters Offered:

Calculus I (MATH 1154) Fall and Spring

Calculus II (MATH 2164) Fall and Spring

Calculus for Business and Economics (MATH 1150) Fall and Spring

Differential Equations (MATH 3233) Fall

Final Semester of Instruction: Fall 2017

Average Number of Students per Course Section: 30

Number of Course Sections Affected by Implementation in Academic Year: 9

Total Number of Students Affected by Implementation in Academic Year: 270

List the original course materials for students (including title, whether optional or required, & cost for each item): Briggs W. L., Cochran L. (2010). Calculus for Scientists & Engineers: Early Transcendental, Pearson. This book is packaged with MyMathLab (MML). MML is required. The cost at the bookstore to the students is \$306.25 (new textbook + MML) Barnett, Ziegler, Byleen. (2015). Calculus for Business , Economics, Life Sciences, and Social Sciences, Pearson. This book is packaged with MML. MML is required. The cost at the bookstore to students is 225.50 (new textbook + MML) Dennis G Zill. (2013). A first Course in Differential Equations with Modeling Applications 10th Edition. Cengage Learning. The cost at the bookstore to students is \$234.00.

Proposal Category: No-or-Low-Cost to Students Learning Materials

Requested Amount of Funding: \$30,000

Original per Student Cost: MATH 1154: \$306.25 per student; MATH 1150: \$225.50 per student; MATH 2164: \$306.25 per student; MATH 3233: \$234 per student

Post-Proposal Projected Student Cost: MATH 1154: \$0.00 per student; MATH 1150: \$0.00 per student; MATH 2164: \$0.00 per student; MATH 3233: \$0.00 per student

Projected Per Student Savings: MATH 1154: \$306.25 per student; MATH 1150: \$225.50 per student; MATH 2164: \$306.25 per student; MATH 3233: \$234.00 per student

Projected Total Annual Student Savings: \$64,860

Creation and Hosting Platforms Used ("n/a" if none):

The Department of Mathematics and Computer Science Webpage
BrightSpace

Project Goals:

The primary goal of this project is to provide and maintain high quality effective no-cost learning materials to students enrolled in differential equations, calculus for business and economics as well as calculus I and calculus II in both electronic and printable format. The purpose is to explore whether the free resources will effect the performance and attitudes of these students in attaining their academic goals. Quantitative data will be compared between two groups-- the experimental group that will be provided with the free resources and the control group which had to purchase the materials. Qualitative data will be collected in the form of interviews to compare the results of both groups. This project is anticipated to impact both STEM majors enrolled in early entry level courses and differential equations, along with business majors enrolled in calculus for business and economics. We expect that the cost savings will have a positive impact on student progression and retention for a large student population at this institution.

Statement of Transformation:

The transformation from high cost materials to no-cost materials will take place over the course of several months leading to and continuing through Spring 2018. Replacing the initial materials for our students enrolled in calculus courses and differential equation courses will be a team effort. Our team will find and adapt free materials as well as create online materials to place on departmental webpage and on BrightSpace to ensure that students have access to these high quality materials.

The **stake-holders** (differential equations, calculus for business and economics, calculus I and calculus II students) come from a student population that is 88% reliant on financial aid with many not receiving a book-voucher to make the book purchase. Even with the book-voucher, students have complained in the past that it was not enough to pay for more than half their books. The **impact of this transformation on stakeholders** will be immediate.

At more affluent academic institutions, students are expected to obtain their course syllabus and start reading the first few chapters prior to the first day of class. By comparison the students that cannot afford their books are discouraged and left behind before they even start the academic semester. At the same time for the instructors this can create a sensitive issue in the teaching process which is now delayed and as a result puts a heavier burden on the later part of the semester to complete the required substantive materials for their courses. The no-cost resources will allow instant access to materials that will have taken days or weeks well into the academic semester because of the lack of finances. This transformation in turn also allows students the foundation for their pathway to success.

The **transformative impact on the course, program, department, institution** will be positive. The location and creation of materials will be selected based on course curriculum and easy student-access to resources. The program will allow students' access to course materials at the beginning of the semester. Through our team's experience, the department would benefit in the short term and long term. That is, more students will have access to course materials from day-one and would make the course more affordable otherwise because of lack of funds. In the long term, the gained experience of putting together materials will inspire and enhance faculty's ability to extending their creativity in that regard to locating and developing free materials for other departmental courses. Through the departmental website and the help of marketing and communications, the students will be informed of the awareness and accessibility of these free resources.

Transformation Action Plan:

All Mathematics faculty members are able to teach calculus for business and economics as well as both calculus I and calculus II courses; however, Dr. Marion and Dr. Cartwright have taught it for a number of years. Each team member will be active in the development and implementation of both printed and online materials needed for availability and accessibility.

Dr. Marion and Dr. Zhu, during spring 2017, will lead in the identification, review and the selection process for the open Calculus (as well as calculus for business and economics) and Differential Equations textbooks. They will also investigate any copyright issues as far as the availability of open source materials are concerned. Dr. Marion is the Calculus I and Calculus II Coordinator and Dr. Zhu is the chair of Mathematics Curriculum Committee. Dr. Marion and Dr. Zhu will find resources and bring them before the Mathematics Curriculum Committee for examination and review prior to making the selection. This will ensure that all content is vetted. Through their past experience and expertise, Dr. Marion will redesign the syllabus to be in

alignment with the calculus textbook and Dr. Zhu will redesign the syllabus to be in alignment with the Differential Equations textbook. During Spring 2017, Ms. Burell will lead the identification, review and selection process for the Calculus for Business and Economics textbooks.

Ms. Burrell, during spring 2017, will organize BrightSpace training on campus, for the team for the Summer 2017 construction of the online resources in BrightSpace. Ms. Burell redesign the syllabus to be aligned with the Calculus for Business and Economics textbook. Ms. Burell is also a Mathematics Curriculum member and will work along with Dr. Marion and Dr. Zhu in the textbook selection and review process.

Dr. Cartwright, during spring 2017, will get Institution Review Board for Human Subjects Research (IRB) approval to conduct the research examining the effectiveness of this project in meeting its goal. Dr. Cartwright will write all reports for all work completed for this project. As a member of the Mathematics Curriculum Committee he will work along with Dr. Zhu, Dr. Marion, Ms. Burell and the other committee members in the book selection process.

Summer 2017, we will work as a team in constructing all resources to be used in both respective calculus courses. That is, actively creating materials in BrightSpace: materials and activities for global use will be linked to our departmental website.

Quantitative & Qualitative Measures: Quantitative measures such as students' grades, pre-test and post-tests will be compared to find whether the no-cost resources were effective in the performance of students. Surveys will also be given to students at the beginning and at the end of each semester to analyze information of each student's response such as age, student classification, previous mathematical background, study habits, use of resources etc. Qualitative measures such as interviews and class discussions will also be analyzed. The following are a set of specific questions for the students: 1. Did the no-cost resources on Brightspace contribute to their understanding of the course materials? 2. Was it easy to understand the online materials presented? Did it help with their understanding of these courses? 3. Did they use any other supplemental materials other than the resources provided? 4. Did they use the Openstax textbook frequently? 5. Do they prefer the Openstax textbook compared to the traditional textbook? The following are a set of specific questions for the faculty teaching the course: -1. Did the pre-selected online assignments meet the needs of these courses? 2. Were they able to easily create the homework assignments and lectures according to their needs as well as the needs of students? 3. How does the quality of the Openstax textbook compare to the traditional textbooks for these courses?

Timeline:

January 2017 to March 2017

Open calculus I and II textbooks, Calculus for Business and Economics and Differential Equation books will be reviewed and vetted for selection. Training for D2L will be scheduled. Human Subjects Research form will be submitted for approval to examine the effectiveness of this project.

April 2017 to May 2017

Calculus I, Calculus II, Calculus for Business and Economics and Differential Equations course syllabi will be redesigned and adapted to the free textbook selected during the Spring 2017 semester.

June 2017 to July 2017

BrightSpace training and consulting will take place. After BrightSpace training as a team, and with the help of consultants, the project team will post assignments for students and have all materials aligned and ready by the end of July.

August 2017-----December 2017

Calculus I, Calculus II, Calculus for Business and Economics and Differential Equations will be piloted using the materials that were constructed and any adjustments to these materials will take place if needed to ensure that all materials for the courses are ready by Spring 2018.

January 2018 to May 2018

Calculus I, calculus II and Differential Equations will be completely ready and integrated.

Budget:

Team Members

Each of the four team members, namely Dr. Patcharin T. Marion, Ms. Bhavana Burell, Dr. Jianmin Zhu and Dr. Samuel Cartwright will be compensated as follows. Upon successful completion of the course construction in Summer 2017, a stipend of \$5000 will be paid to each team member in accordance with the applicable university policies and procedures. On an ongoing basis it is understood that the monitoring and the updating of the materials will be done throughout the duration of this grant period.

Adjunct Professor

An Adjunct professor will be compensated (\$2000) to cover one of the classes for one of the faculty team members during Fall Semester 2017 and Spring Semester 2018 so that the no-cost to students resource materials are maintained and project reports are created in a timely manner.

BrightSpace Support Consultant

A BrightSpace support specialist or a professor with expertise using BrightSpace will be compensated to work as a part of our support staff. He/she will provide support technical assistance to the Project Team. This will ensure that all the materials and resources will be in place and ready.

Traveling and Lodging for Training

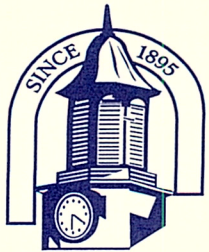
Team members will set aside \$800 to be used for travel expenses to attend the grant kick-off

meeting.

Item	Unit Cost	Number	Total
Faculty salary	\$5,000	4	\$20,000
Adjunct Professor Pay to cover Release Time	\$2,000	2	\$4,000
BrightSpace Support Consultant (To be determined)	\$2,300	2	\$4,600
Traveling and lodging for training	\$800	Project Team	\$800.00
Materials --paper, printing, pens etc.	\$600	Project Team	\$600.00
Total Cost			\$30,000

Sustainability Plan:

Business Calculus, Calculus I and Calculus II courses are offered each semester throughout the year and Differential Equations is offered once a year. The department's full adoption of these transformed courses will ensure that they are reviewed annually for improvement and sustainability for students and faculty. Furthermore, future funding will be sought to enhance and improve other Mathematics courses such as Statistics and Quantitative Reasoning in order to increase the use of no-cost-to-student resources to ensure the stability and longevity of these benefits to our students' in the future.



July 7, 2016

Affordable Learning Textbook Transformation Grant
Review Committee

Dear Committee Members:

On behalf of the Department of Mathematics and Computer Science, I am pleased to support the proposal of “No Cost to Student Resources for Differential Equations, Business Calculus, Calculus 1 and II”

The Department of Mathematics and Computer Science at Fort Valley State University offers programs of study leading to the Bachelor of Science degrees, with majors in Mathematics and Computer Science. Additionally, the department offers minor concentrations in these same areas, in Applied Statistics and in Nuclear Science and Engineering. In collaboration with the school of Education, the department also offers courses leading to graduate and undergraduate degrees in Education with concentration in Mathematics. The department also participates in several 3+2 dual degree programs, in conjunction with FVSU's Cooperative Development Energy Program (CDEP). Through CDEP dual degree program, students obtain a B.S. degree in Mathematics from FVSU and a second B.S. degree in engineering, geosciences or health physics, from Georgia Tech (GT), the University of Nevada Las Vegas (UNLV), Penn State University (PSU), the University of Texas-Austin (UT-Austin), the University of Texas Pan American (UTPA), and the University of Arkansas (UARK).

Our Mathematics program, which is ranked top in the nation for producing African-American math graduates by *Diverse Magazine* (2015, 2014 and 2011), is well prepared to adopt the transformed courses.

We have the technology and laboratories required to facilitate student support for the on-line, free text resources. Dr. Cartwright and his team have all the qualifications and experience needed to meet the goals and objectives in the proposal. Their years of experience and expertise in the pedagogy and technology required for differential equations, calculus series courses and will ensure the success of the proposed transformation. I am excited about the potential financial savings this project would offer our students. Calculus I and Calculus II courses are offered each semester throughout the year and differential equations is offered every year. The department will review and assess these transformed courses annually and will seek funds as required to insure sustainability and improvement.

Sincerely yours,

Dawit Aberra, Ph. D., Chair
Department of Mathematics and Computer Science

1.8 REFERENCES & ATTACHMENTS

References

- Fischer, L., Hilton III, J., Robinson, J., & Wiley, D. (2015). A multi-institutional study of the impact of open textbook adoption on the learning outcomes of post-secondary students. *Journal of Computing in Higher Education*, 27(3), 159-172. Retrieved November 17, 2015, from <http://link.springer.com/article/10.1007/s12528-015-9101-x/fulltext.html>
- Klymkowsky, M. (2007). Feature Point of View: Textbooks—Essential or Superfluous? Teaching without a Textbook: Strategies to Focus Learning on Fundamental Concepts and Scientific Process. *CBE—Life Sciences Education*, 6, 190-193.
- Senack, E. (2014). Fixing the Broken Textbook Market: How Students Respond to High Textbook Cost and Demand Alternatives. Center for Public Interest Research.

Attachments

1. Letter of Support

Syllabus

FORT VALLEY STATE UNIVERSITY
College of Arts and Sciences
Department of Mathematics and Computer Science
Fall Semester, 2017

COURSE SYLLABUS
Differential Equations
MATH 3223

(3 Sem. Hrs.)

INSTRUCTOR: Dr. Jianmin Zhu, Professor
OFFICE: 312 W. W. E. Blanchet CTM Building
TELEPHONE: (478) 827-3067
DEPARTMENT TELEPHONE: (478) 825-6430
E-MAIL: zhuj@fvsu.edu
OFFICE HOURS: 10:00 AM – 11:00 AM, MWF; 1:30 PM – 4:30 PM, MW; 1:30 PM – 2:30 PM, F or by appointment

Course Description: Many mathematical models of real life systems or phenomena involve equations that contain derivatives of unknown variables. These equations are called differential equations. In this course, procedures will be developed to solve first order differential equations and second order and higher linear differential equations.

PREREQUISITE: MATH 2174 (Calculus III)

Textbook: Elementary Differential Equations, Williams F. Trench, Free Edition 1.01 (December 2013) <https://digitalcommons.trinity.edu/mono/9/>

Supplementary Readings:

1. A First Course in Differential Equations with Modeling Applications, Dennis G. Zill, 10th Edition, Brooks/Cole, Cengage Learning, Inc., 2013; ISBN: 9781111827052
2. Elementary Differential Equations, 7th edition, by Boyce, DiPrima, Wiley, 2001.
3. Fundamentals of Differential Equations, 5th edition, by Nagle, Saff, Snider , Addison Wesley Longman, 2000.
4. Differential Equations with Computing and Modeling, 3rd edition by Edwards and Penney, Prentice Hall, 2004

Departmental Major Area Learning Outcomes:

This course addresses the following major area learning outcome:

VI. Students will demonstrate the knowledge of broad areas of mathematics, and will have ability to synthesize mathematical concepts and techniques and solve non-routine

and applied problems. (Course Learning Outcome I, Objectives 5 and 6 ; Course Learning Outcome II, Objective 3 ; Course Learning Outcome III, Objectives 3 and 4)

Course Learning Outcomes:

I. Students will learn the definitions and terminology of differential equations and be able to model equations governing physical phenomena. They will find the solutions of some special types of first order differential equations.

Objectives:

1. State definitions of terms using complete sentences.
2. Classify differential equations by type, order, etc...
3. Show that a function is a solution of a given differential equation.
4. Write differential equations governing physical situation's such as spring-mass system, simple pendulum, etc...
5. Solve the first order separable, linear, exact, homogeneous, Bernoulli type differential Equations and solutions of some differential equations by substitution methods
6. Solve application problems such as growth and decay, cooling of bodies, current in a series circuit, etc...

II. Students will study higher order differential equations, solution techniques and applications to real life problems.

Objectives:

1. Solve problems involving initial values.
2. Determine whether a set of functions is linearly independent or dependent.
3. Solve homogeneous linear equations with constant coefficients, by the method of undetermined coefficients and variation of parameters.
4. Solve equations describing simple harmonic, damped, or forced motion.

III. Students will analyze differential equations with variable coefficients and apply Laplace transform methods to solve certain types of differential equations.

Objectives:

1. Solve the Cauchy-Euler equations.
2. Solve certain type of nonlinear equations.
3. Find power series solutions about an ordinary point and a singular point.
4. Use Laplace transform to solve differential equations.
5. Derive and use the properties of Laplace transform.

Suggested Schedule:

Week(s)

- 1-4 Introductions to Differential Equations and First-Order Differential Equations - Exam 1
- 5-7 Higher-Order Differential Equations - Exam 2

8-10 Models with Higher-order Differential Equations and Series Solutions of Linear Equations - Exam 3

11-14 The Laplace Transform and Solutions of Differential Equations - Exam 4

15 Final Exam

Grading:

1. Attendance: You are to attend every class for the entire class period. Once roll has been taken, you are NOT to leave the classroom until the instructor dismisses the class. Final grades for the course may be reduced for excessive absences (maximum allowed is 3 absences). For the purpose of attendance, **three (3)** times being late and/or leaving class early will count as an absence.

2. Tests: There will be four 100-point exams and a 100-point comprehensive final exam. No missed test can be made up unless the instructor excuses the absence, in which case, the make-up should be taken within three days of the test.

3. Quizzes: Quizzes will be given online.

4. Homework: Homework assignments given in the class reflect the minimum work expected.

5. Course Grade: The **midterm grade** for the course will be based on the two exams (Exam 1 and Exam 2), and the extra credit quizzes given before the midterm. The **final grade** for the course will be based on the four exams, the final exam, and the quizzes given during the semester. The **midterm letter grade** and the **final letter grade** will be assigned using the following scale:

at least 90%	-----	A
at least 80% but less than 90%	-----	B
at least 70% but less than 80%	-----	C
at least 60% but less than 70%	-----	D
less than 60%	-----	F

6. It is your responsibility to notify the instructor at the end of class that you came in late. Failure to do so at that time will result in your remaining as absent on the instructor's roll. This change in attendance status can NOT be made at any other time.

7. Students who accumulate more than 12 absences during the semester will be recommended for a "WF" grade at the end of the course. This grade is administered by the Registrar's office and impacts the student's GPA comparable to an F grade. Additionally, the grade is counted in the 18 hours maximum allowed for withdrawals.

INVOLUNTARY WITHDRAWAL POLICY

If after the mid-semester period, the instructor verifies that a student has accumulated the following number of unexcused absences from the class, the student is subject to involuntary withdrawal from the class and will receive a final course grade of "WF."

- The student is absent 20 or more days for a class (including labs) that meet 4 days per week.
- The student is absent 15 or more days for a class that meets 3 days per week.
- The student is absent 10 or more days for a class meets 2 days per week.
- The student is absent 6 or more days for a class meets 1 day per week.

FVSU'S CURRENT POLICIES AND PRACTICES REGARDING PLAGIARISM AND ACADEMIC DISHONESTY

Student Academic Dishonesty. Expulsion or suspension from the University or any lesser sanction may be imposed for the commission of offenses involving cheating or defraud on examinations. Examples of such offenses include giving assistance not authorized by the instructor in the preparation of an essay, laboratory report, examination or other assignment included in an academic course; taking or attempting to take, steal, or otherwise procure in an unauthorized manner, any material pertaining to the conduct of a class, including but not limited to examinations, laboratory experiments, and roll books; and plagiarizing.

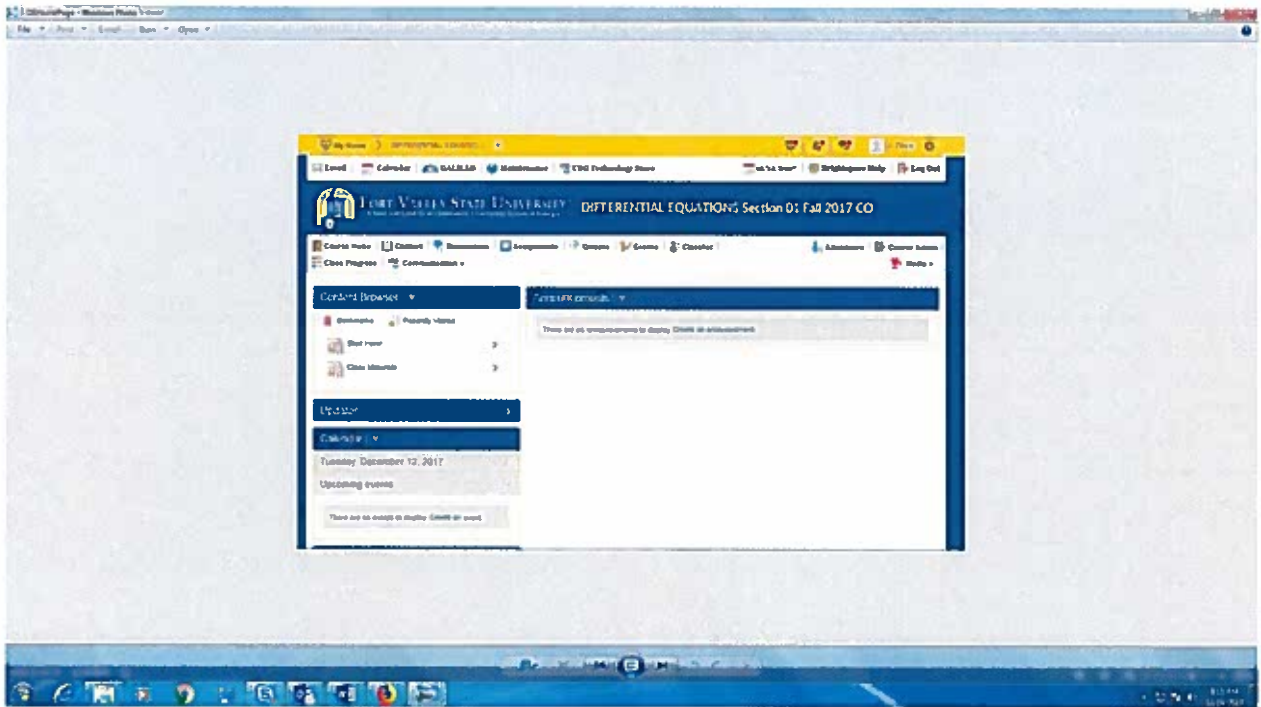
Plagiarism. The appropriation of someone else's ideas, passages arguments, interpretation of events or factual information, in either hard copy or electronically, demonstrates a lack of integrity and is unacceptable at Fort Valley State University. Other examples of plagiarism include submitting someone else's work/assignment as one's own, submitting purchased papers as one's own, and submitting papers from the Internet as one's own. Students who are guilty of plagiarism are subject to disciplinary action. Acts of plagiarism must be reported to the Department Head, Dean, Vice President for Academic Affairs, and the Vice President for Student Affairs for appropriate action. (2006 – 2008 Fort Valley State University Undergraduate Catalog, 71-72.)

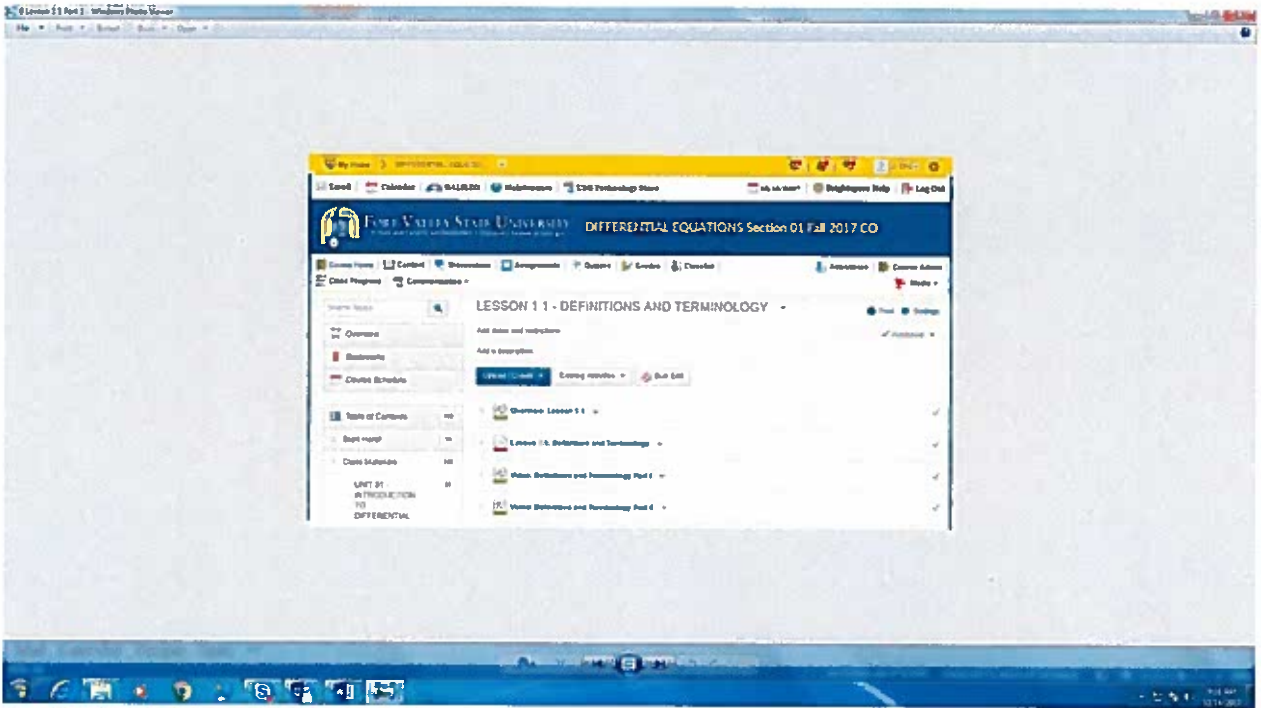
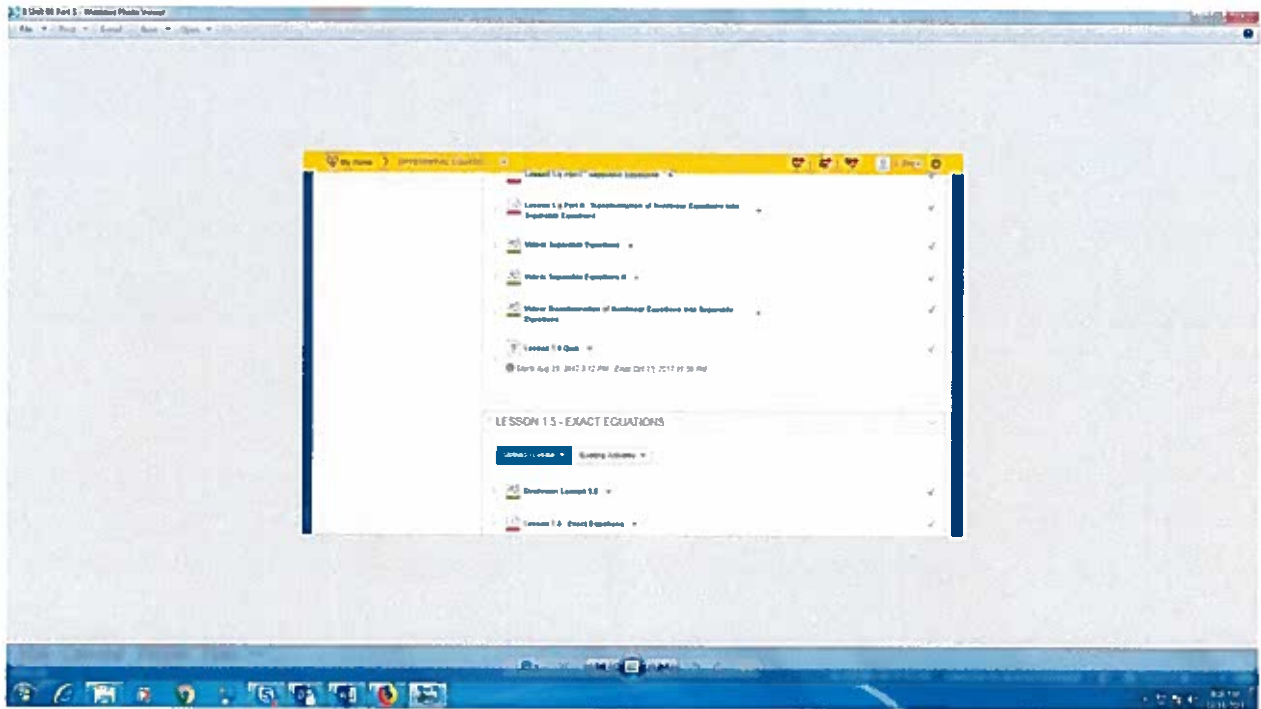
DISABILITY

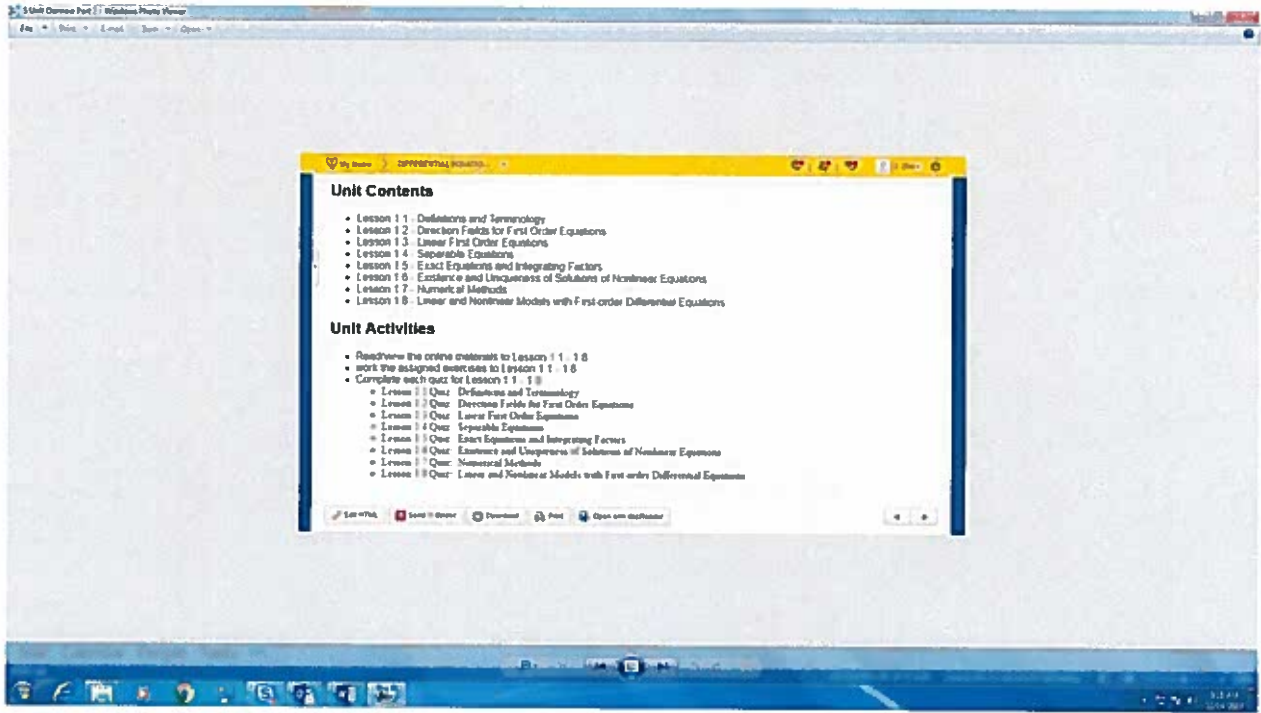
FVSU is committed to the full inclusion of individuals with disabilities. To that end, the policies and procedures of FVSU ensure that a person with a documented disability is not, on the basis of that disability, denied full and equal access to academic programs, nor excluded from participation in co-curricular activities, or otherwise subjected to discrimination in such programs and activities. The policies for individuals with disabilities at FVSU are designed to ensure full compliance with all pertinent federal and state legislation, specifically to include Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990. If a student requires disability accommodations, he/she must register with the Office of Disability Services. To register

online please visit : <http://www.fvsu.edu/disability-services/>. You may also call (478) 822-1072, or visit the Royal C. Peabody Bldg. Room 125.

Disclaimer: The above schedule and procedure are subject to change in the event of extenuating circumstances.







Final Report

Date: 12/13/17

Grant Number: 246

Institution Name(s): Fort Valley State University

Team Members: There are 4 team members:

1. Professor Bhavana Burell, Mathematics and Computer Science Lecturer, Department of Mathematics and Computer Science, burellb@fvsu.edu
2. Dr. Samuel Cartwright, Associate Professor of Mathematics, Department of Mathematics and Computer Science, cartwris@fvsu.edu
3. Dr. Patcharin Marion, Associate Professor of Mathematics, Department of Mathematics and Computer Science, tragoosirisakp@fvsu.edu
4. Dr. Jianmin Zhu, Professor of Mathematics, Department of Mathematics and Computer Science, zhuj@fvsu.edu

Project Lead: Dr. Samuel Cartwright

Course Name(s) and Course Numbers:

Calculus I (MATH 1154)

Calculus II (MATH 2164)

Calculus for Business and Economics (MATH 1150)

Differential Equations (MATH 3223)

Semester Project Began: Spring 2017

Semester(s) of Implementation: Fall 2017

Average Number of Students Per Course Section:

Calculus I (MATH 1154) – 35 Students

Calculus II (MATH 2164) — 13 Students

Calculus for Business and Economics (MATH 1150) – 32 Students

Differential Equations (MATH 3223) – 6 Students

Number of Course Sections Affected by Implementation: 4 Courses

Total Number of Students Affected by Implementation: 86 Students

1. Narrative

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

Transformation Summary

The learning experience was a positive one in that we were able to find and create materials for Calculus I, Calculus II, Calculus for Business and Economics, and Differential Equations so that students in these courses did not have to pay for any course materials needed.

Uploading quizzes using the software Respondus was a challenge. This is because images seem to be scattered on a couple of quizzes that were uploaded.

Finding videos online that were aligned with course content was sometimes challenging because we had to be sure examples followed the content covered. For example, for the Calculus for Business and Economics course, examples of derivatives for trigonometry in the openstax textbook were not needed because there was no trigonometry in the course content and many videos had many examples with the trigonometry content.

- Transformative impacts on your instruction

The location and creation of materials was in Brightspace which allowed all students to easily access the resources. The materials were readily available at the beginning of the semester. This increased the number of students having access to the materials from day-one to 100%. Faculty gained experience of putting together materials with the help of an Online Instructional Professional.

Transformative Impacts

Students were able to save a total of \$23, 320.00 (see Table 1A).

Table 1A

Course	Number of Students Enrolled	Cost of Textbook	Students' Savings
MATH 1154	35	\$306.25	\$10,718.75
MATH 2164	13	\$306.25	\$3,981.25
MATH 1150	32	\$225.50	\$7,216.00
DMATH 3223	6	\$234.00	\$1,404.00
Total Savings			\$23,320.00

Table 1B gives the breakdown of the students served by the project. It also gives a breakdown on students with experience using Brightspace before entering the project courses. At least 48% or more of the student who participated in this project used Brightspace. Passing grades consists of A, B, and C. Non-passing grades consist of D, F, WF, and F. For Calculus I 21 of the 25 students expected to pass the course. For Calculus II 7 of the 8 students expected to pass. For

Differential Equations students did not answer that question. For Calculus for Business and Economics 24 of the 25 students expected to pass the course.

Table 1B

Data Questions	Calculus I	Calculus II	Differential Eq.	Business Calculus
Gender	16 Male 9 Female	4 Male 4 Female	4 Male 2 Female	8 Male 16 Female
Age	23 Ages 18- 22 1 Ages 23 - 27	6 Ages 18- 22 2 Ages 23 - 27	6 Ages 18- 22	12 Ages 18- 22 9 Ages 23 – 27 4 Over 27 years
Students enrolled in the course	25	8	6	25
Expected Grade out of the course	8 – A; 2 – B; 11 – C; 3 – D; 1 – F.	1-A; 2-B; 4-C; 1-D.		9-A; 9-B; 6-C; 0-D; 1-F.
Students who have taken a Math course in D2L before.	56%	63%	67%	48%

Lessons Learned

When creating questions using Brightspace, all instructors used only multiple choice questions because of time constrains. In future, after having gained experience using Brightspace and knowledge to create the course content, post open ended questions will be used to edit and update the course materials.

For Calculus for Business and Economics the search for more reasonable textbook will have to continue. The textbook selected was for a general calculus course and many examples using trigonometry dominated the textbook. Updating the course with an applied calculus textbook or one that caters to business will be in the works.

2. Quotes

Below are three quotes from students on the videos and its content.

Student 1

The course lecture videos are somewhat assisting and I do refer to them often, however I try to refrain from the videos that have actual instructor view. I am most comfortable watching the videos that have the black background along with using colored text for highlighting, these videos to more are most demonstrative, easy to view, and appealing to hear.

Student 2

No the video did not help understand the topic being discussed. I may need extra help trying to understand the problems being discussed.

Yes. I would watch the video again to try to get a better understanding of the lesson.

The quality of the video in terms of the sound, visual, and content was very clear to my understanding.

Student 3

Yes. I am a visual learner and being that close and going step by step with the tutor helped me understand a bit easier. Also being able to pause and rewind made things a lot easier.

Yes. [I would watch the video again]

Everything [the video] was clear on my end, in all aspects.

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?

The overall student opinion was mixed. Table 1C gives a breakdown of student's opinions about the materials.

There were positive opinions on: students downloading and printing a hard copy. For example, 50% or more of the students downloaded their respective textbook: that is 60% of Calculus I students, 50% of Calculus II students, 67% of Calculus for Business and Economics students and 68% of Differential Equations students.

With the exception of Differential Equations, most students were positive or excited about using the online materials. That is, 76% of Calculus I students, 100% of Calculus II students, 76% of Calculus for Business and Economics students and 40% of Differential Equations students.

With the exception of Differential Equations students were able to complete their homework before it was due. That is, 92% of Calculus I students, 100% of Calculus II students, 92% of Calculus for Business and Economics students and 40% of Differential Equations students.

The response on the need for needing more resources for course success was somewhat neutral. Even though more than 56% of students did not need any additional resources for their class. With the exception of Differential Equations who had no need: the other courses showed that 40 to 44% needed more resources. That is, 60% of Calculus I students, 63% of Calculus II students, 56% of Calculus for Business and Economics students and 100% of Differential Equations students.

Table 1C

Survey Questions	Calculus I	Calculus II	Differential Eq.	Business Calculus
Download and View eTextbook	60%	50%	67%	68%
Referenced the textbook 7 or more times per week	15%	25%	67%	20%
Referenced the textbook for new materials	36%	88%	50%	32%
Logged 9 or more times per week into D2L	12%	40%	50%	20%
Spent 3 or more hours on homework in D2L	64%	88%	50%	40%
Current online Homework accessed in D2L	80%	100%	83%	64%
Students completed homework before it was due	92%	100%	40%	92%
Students were certain correct answers were entered in the first try in D2L.	32%	35%	50%	48%
Students looked for any mistakes in their work when D2L told them their answer was incorrect	40%	50%	13%	40%
Students worked alone on their homework in D2L	40%	100%	75%	80%
Students excited about using free resources	76%	100%	40%	76%
Students who did not need any additional resources for their classes	60%	63%	100%	56%

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?

Table 2 shows student performance in Calculus I for Spring 2017 and Fall 2017. The initial impact on student performance is positive. There was an increase of 14% passing.

Table 2.

Calculus I (MATH 1154)			
Semester	Number of A, B, Cs	Number of D, F, W, WF	% passing
Spring 2017	9	30	23
Fall 2017	13	22	37

Table 3 shows student performance in Calculus II for Fall 2016 and Fall 2017. The initial impact on student performance is positive. There was an increase of 11% passing.

Table 3.

Calculus II (MATH 2164)			
Semester	Number of A, B, Cs	Number of D, F, W, WF	% passing
Fall 2016	3	8	27
Fall 2017	5	8	38

Table 4 shows student performance in Calculus for Business and Economics for Fall 2016 and Fall 2017. The initial impact on student performance is negative. There was an decrease of 18% passing.

Table 4.

Calculus for Business and Economics (MATH 1150)			
Semester	Number of A, B, Cs	Number of D, F, W, WF	% passing
Fall 2016	23	11	68
Fall 2017	16	16	50

Table 5 shows student performance in Calculus I for Fall 2016 and Fall 2017. The initial impact on student performance is neutral. Student performance remained unchanged.

Table 5.

Differential Equations (MATH 3223)			
Semester	Number of A, B, Cs	Number of D, F, W, WF	% passing
Fall 2016	6	0	100
Fall 2017	6	0	100

3b. Narrative

For both Calculus I and Calculus II performance showed an improvement from using the traditional adopted textbook to using the free resources. That is a 14% and 11% respectively from Spring 2017 to Fall 2017. The impact of the materials on student performance for Differential Equations went unchanged. This is good news in that all students had success in passing the course during the Fall 2016 and Fall 2017 semester. Unfortunately, student in the Calculus for Business and Economics performance showed a negative impact. Comparing Fall 2016 with Fall 2017, we found a drop of 18% in passing.

For Calculus I, Calculus II and Differential Equations, the textbook and materials were all from traditional type textbooks. For Calculus for Business and Economics the textbook was a traditional textbook for calculus. Students enrolled in the Calculus for Business and Economics course had only the College Algebra as prerequisite. The additional content involving trigonometry could have created a negative factor in that students say mathematics they did not have the foundation for as they worked through problems. This may have caused a negative impact on student performance.

4. Sustainability Plan

The department's full adoption of these transformed courses has ensured that they will be reviewed annually for improvement and sustainability for students and faculty. Furthermore, with the exception of Differential Equations all of these courses are offered every semesters with the same instructors teaching the courses. Our teams' commitment to that end enhances the assurance.

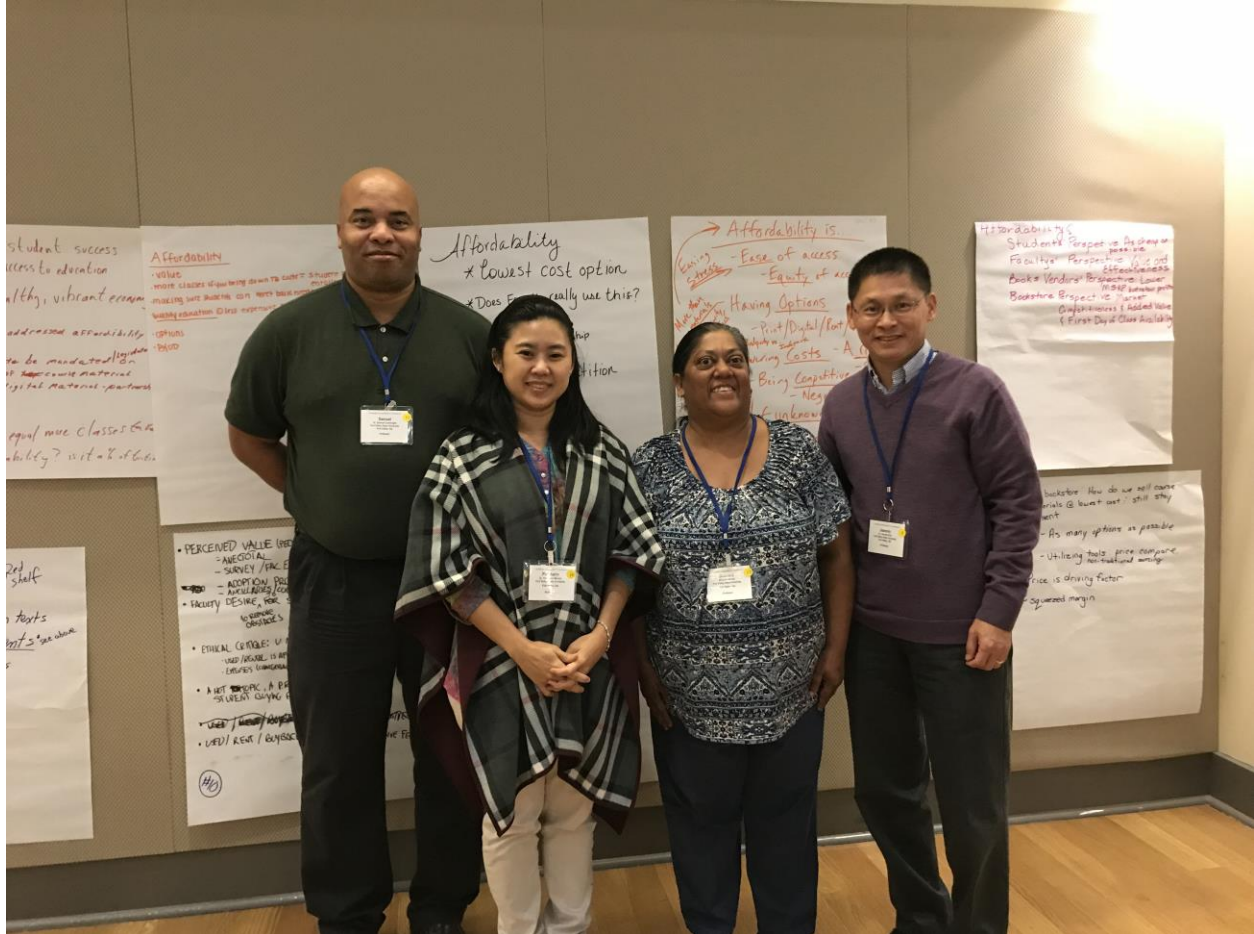
5. Future Plans

This project had positive influence on our thinking in terms of teaching and learning. The process of using D2L to create materials and organize materials for students to learn has provided a foundation to build on. That is, for creating more similar materials and well as taking what works and building upon for future use in the improvement of the course design.

This project experience, its impact on student performance, and the importance of these programs are things that we will share with other with vested interest. Paper, presentations and

publications are all in the works. The MAA Southeastern Regional Meeting at Clemson University is a target event for our first presentation on this project.

6. Description of Photograph



(left-right) Dr. Samuel Cartwright, Project Lead and Instructor of Calculus for Business and Economics as well as instructional designer, Dr. Patcharin Marion, Calculus Coordinator and Instructor of Calculus I and Calculus II as well as instructional designer, Professor Burell, Calculus I instructional designer and Calculus for Business Consultant, Dr. Jianmin Zhu, Instructor of Differential Equations as well as instructional designer.