Application Details

Manage Application: ALG Textbook Transformation Grants

Award Cycle:	Round 9
Internal Submission Deadline:	Sunday, April 30, 2017

Application Title:	312
Application ID:	#001746
Submitter First Name:	Patty
Submitter Last Name:	Wagner
Submitter Title:	Assistant professor
Submitter Email Address:	patty.wagner@ung.edu
Submitter Phone Number:	706-867-4515
Submitter Campus Role:	Proposal Investigator (Primary or additional)
Applicant First Name:	Patty
Applicant Last Name:	Wagner
Co-Applicant Name:	Marnie Phipps
Applicant Email Address:	patty.wagner@ung.edu
Applicant Phone Number:	706-867-4515
Primary Appointment Title:	Assistant professor
Institution Name(s):	University of North Georgia
Submission Date:	Monday, May 1, 2017

Proposal Title:	312
Final Semester of Instruction:	Spring 2018

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

Patty Wagner, Assistant Professor, Mathematics, patty.wagner@ung.edu

Marnie Phipps, Associate Professor, Mathematics, marnie.phipps@ung.edu

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

John Cruthirds, Department Head, Department of Mathematics, University of North Georgia

Course Names, Course Numbers and Semesters Offered:

Mathematical Models, MATH 1101, offered fall, spring, & summer semesters

Average Number of Students per Course Section:	30
Number of Course Sections Affected by Implementation in Academic Year:	10
Total Number of Students Affected by Implementation in Academic Year:	300
List the original course materials for students (including title, whether optional or required, & cost for each item):	Graphing calculator required (TI-83, TI-83+, TI-84, or TI-84+ preferred), $100Required Textbook: Mathematical Application for the Management, Life, and Social Sciences by Harshbarger & Reynolds. Students choose from the following options:1) UNG custom package with Web Assign code (hardcopy textbook), $165 or2) Web Assign plus ebook access, $94
Proposal Categories:	Specific Top 50 Lower Division Courses
Requested Amount of Funding:	10,800
Original per Student Cost:	$194 - $265, depending on textbook options. $194 includes only an e-book and calculator; $265 includes a hardcopy text, e-book, and calculator.
Post-Proposal Projected Student Cost:	$0. Our goal is to provide all materials to students at no cost.
Projected Per Student Savings:	$194 - $265, depending on textbook option.
Projected Total Annual Student Savings:	$58,200 - $79,500

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

In the planning phase of summer and fall 2017, all materials will be hosted on the University of North Georgia’s shared U drive. This drive is accessible by all UNG faculties regardless of campus location. After one pilot semester, beginning spring of 2018, these resources will be offered to the University of North Georgia’s Nighthawks Open Institutional Repository. At the completion of the project, the resources will also be made available through the Georgia

Knowledge Repository, and the GALILEO Open Learning Materials repository.

Project Goals:

Many non-STEM majors enroll in introductory mathematics modeling courses to fulfill general university requirements for quantitative reasoning. In our experience, many of these students experienced difficulty learning mathematics in the K-12 school setting and their affinity for the subject has been severely diminished. The mathematics modeling course is particularly suited for these students because context allows students to consider mathematics from an intuitive, concrete perspective. Through initial explorations and a focus on multiple representations, and with an eye towards building a mathematical toolbox for problem solving, students may come to realize that mathematics is far more than rules and procedures. Unfortunately, our research suggests that many commercial textbooks do not capitalize on these aspects of a mathematics modeling course (Phipps & Wagner, 2017). Rather, textbooks written for mathematics modeling courses tend toward more traditional presentations; one in which mathematics is presented as a way to understand the world rather than the other way around.

Our goals for this project are four-fold. First, we desire to design a course and identify course materials that align with National Council of Teachers of Mathematics' [NCTM] (2014) effective teaching and learning practices. These practices were developed through research in an effort to ensure mathematical success for ALL students. Rather than relying on a traditional textbook format, we will identify and compile effective student and instructor resources that are freely available. Second, our goal is for students in mathematics modeling courses to show progress in productive dispositions (National Research Council, 2001). Specifically, students will find mathematical success attainable, recognize the value in perseverance and productive struggle, perceive mathematics as a discipline involving reasoning and sense making, and view mathematics as a relevant tool for problem solving. Third, our goal is to have students demonstrate content knowledge growth of the essential components of this course as designated by the University System of Georgia [USG] syllabus for mathematics modeling. Students' growth will be demonstrated both conceptually and procedurally in contexts designed to make sense of worldly phenomena. Last, we want to reduce the financial burden to students by using publicly available resources. Ultimately, this grant will provide an opportunity to incorporate current research in teaching and learning practices to engage students in new and innovative ways, while reducing students' cost to zero.

Statement of Transformation:

We intend to transform our institutional mathematics modeling course from a textbook driven, traditional lecture approach to one that encourages and develops students' critical thinking and problem solving. As such, we propose to develop resources for the instructor's use as much as the students'. Our materials will suggest ways to ensure that important mathematical concepts are highlighted through in-class work and discussions. We will also suggest websites students can visit for extra practice or information.

Our mathematics modeling course will consist of classwork in the form of high cognitive demand tasks, on which students will work in teams. We may create some of these tasks, but many will be intentionally selected from publicly available resources, including OERs, mathematics-specific organizations, and interested individuals (for example, Arnolds et al., 2007; Mathematics Assessment Resource Service, 2007; and Meyer, n.d., respectively). These tasks will introduce topics from the USG syllabus for mathematics modeling.

For each topic, we will provide a task--or a link to a publicly available task, depending on copyright and licensing requirements--as part of an instructional packet. For each of these tasks, we will create lesson resources that identify appropriate scaffolding questions for students who are struggling. Additionally, we will identify common methods students might use to solve the task and suggest a sequence of presentation for the follow-up whole class discussion. Our lesson resources will suggest connections that can be made between methods and representations and ways to highlight the relevant mathematics. We will also identify appropriate follow-up practice and free technology apps (e.g. www.desmos.com and GeoGebra) that can foster students' connections between algebraic, graphic and numeric representations. These free technology applications will replace the currently required graphing calculators and are arguably superior to calculators for exploration and developing connections. In this technological age, we anticipate that students will be able to use smartphone capabilities to access applications for spreadsheets, graphing data and functions, and various calculations. Students without a smartphone will be able to rely on campus computers. We will substitute our current WebAssign online practice with in-class work, projects, individual paper-and-pencil practice problems, and online practice websites.

Initially, the transformation has the potential to impact students taking this core class with an instructor who has adopted our materials. We will offer our resources to all instructors of MATH 1101 or similar modeling courses; instructors will gain full access to lesson plans, in-class tasks, Power Points, sample projects, tests, etc. beginning spring 2018.

Beyond the savings in material costs generated by students, we believe that this innovated course will impact students’ view of mathematics as a discipline and their own affinity for it. We also believe that we will see increased student success, particularly among student groups who have traditionally struggled with mathematics. These groups include non-traditional students, first-generation students, and those who have been enrolled in remedial or support courses.

We consider this project an ongoing effort to transform the mathematics modeling course. ALG funds will allow for an intensive initial effort in restructuring the course; however, we intend to continue making modifications and adjustments as a result of program assessments. As we compile evidence supporting the positive impact of our resources and methods, we expect more and more faculty across UNG’s five campuses to adopt them. Our department has launched an open discussion about OERs and their role in teaching and learning. This project will serve as evidence of their effects. We anticipate this course restructure will have a positive

impact on students who might otherwise have struggled to meet institutional quantitative requirements.

We will also share our results and materials at state conferences such as the USG Teaching and Learning Conference hosted in Athens, GA or national conferences such as the Research Council on Learning Mathematics. Exposure through these modes of professional development creates a possibility for impacting mathematics modeling courses within and outside the state of Georgia.

Transformation Action Plan:

The ALG team consists of Patty Wagner and Marnie Phipps. We each earned a doctorate in the field of mathematics education and train future secondary mathematics teachers at our institution. Our pedagogical choices are informed by the literature about how students learn mathematics and how to ensure mathematical opportunity for ALL students. Our interest in this project stems partly from the findings of our recent analysis of mathematics modeling textbooks used in the state of Georgia (Phipps & Wagner, 2017). Noting that these textbooks largely lack characteristics of NCTM's (2014) effective teaching and learning practices, we brainstormed ways in which the course could be restructured to capitalize on these practices. We noted that excellent resources are already publicly available but need to be identified, modified for the MATH 1101 course, and supplemented with pedagogical decisions. To that affect, our action plan follows.

We will identify our resources and create initial instructional plans prior to the fall 2017 semester. We will begin with our department's syllabus for the course as written, but will propose changes as needed. We will refer to our department head, John Cruthirds, and the USG Academic Committee's (2014) Math 1101 Intro to Math Modeling Outline to ensure any proposed changes meet departmental approval and USG guidelines. Following NCTM's (2014) practices of effective teaching and learning, we will establish unit goals and objectives, with an eye towards what mathematics is to be learned, why is it important, how it relates to prior mathematical learning, and to what mathematical ideas we are heading. We will then create or search publicly available resources for tasks that "promote reasoning and problem solving" (NCTM, 2014, p. 17) and that will serve to meet the unit objectives. As mentioned early in this proposal, course materials under consideration may originate from Mathematics Assessment Resource Service (2007) or Meyer (n.d.) for classroom engagement activities and Arnolds et al. (2007) as practice problems for students.

We are seeking materials which contain wide entry levels and which allow for individual expression and representation. We will select materials that enable students to start with their personal prior knowledge base and expand mathematical learning through scaffolding questions. Scaffolding questions are typically open-ended and designed to help a student focus on the relevant mathematics without taking over the student's thinking (NCTM). If a selected task does not include suggested scaffolding questions, we will create these to include

in course materials. We will then describe how a follow-up class discussion can connect the various solution strategies in ways that move students toward a conceptual understanding of the relevant mathematics. By connecting strategies and representations to their own experiences, students can develop an understanding from which they can build procedural fluency (NCTM). Our description of the follow-up whole class discussion will include suggestions for sequencing of strategy presentations, open-ended questions to elicit connections between strategies or representations, and ideas for ensuring that the relevant mathematical ideas are emphasized. Finally, we will identify practice problems to help build procedural fluency, projects that make use of the mathematical ideas, and/or links to online student resources.

In fall 2017, as instructors of record, we will each implement the designed course in a single section of MATH 1101. After each instructional session, we will reflect separately on its effectiveness and note changes that should be made. We will meet with each other weekly to compare our qualitative assessments of each task and make appropriate adjustments or modifications. In spring 2018, we will designate a control section of MATH 1101 that will retain the original departmental design. Phipps and Wagner will each teach a transformed version of MATH 1101 using our developed resources. We will conduct our formal assessment of the project during this semester.

The resources we develop will be compiled as lesson plans, tasks, instructional PowerPoint presentations, links to student practice and resources, etc. for each unit in the mathematics modeling course. As such, they will represent a more complete resource for instructors than the typical textbook. We will organize these resources to maximize ease of use by instructors and make them available electronically to all UNG instructors through the institution’s shared U drive in fall of 2017. Additionally, we will make the resources publicly available to the University of North Georgia’s Nighthawks Open Institutional Repository beginning spring of 2018. At the completion of the project, the resources will also be available through the Georgia Knowledge Repository and the GALILEO Open Learning Materials repository. In the following academic year, introductory webinar’s will be offered each semester to instructors using these materials.

Quantitative & Qualitative Measures:

Goal 1 is to design a course and course materials that align with NCTM's (2014) effective teaching and learning practices.Phipps and Wagner (2017) have established qualitative criteria to determine the extent to which curriculum materials meet NCTM's guidelines. Using this tool, we will measure materials created and designed for Math 1101. This will occur before materials are released for public use the start of the semester in January 2018.Goal 2 is for students in mathematics modeling courses to show progress in productive dispositions.We will create or find an appropriate Likert-scale online survey with questions about views of math, self-efficacy, and dispositions. Surveys will be administered both pre- and post-semester. Additionally, we will conduct short interviews with two focus groups of up to 4 students on their experiences with mathematics and the course. Surveys and focus group interviews will occur fall and spring semesters.Goal 3 is to have students demonstrate content knowledge growthWe will administer pre- and post-tests to measure student growth for specific course objectives to all students in the experimental Math 1101 course and conduct a matched pairs analysis to measure student growth. The pre-test will also be administered to the students in the control course to test for significant differences in incoming ability levels. We will attempt to measure at-risk subgroups within our population; however, small sample sizes may limit the number and kinds of subgroups analyzed. Possible subgroups may include non-traditional students, first-generation students, and those who have been enrolled in remedial or support courses. Content testing will occur in both fall and spring semesters.Goal 4 is to reduce the financial burden to students by using publicly available resources.In the past two academic years, 628 students have taken this course on the Dahlonega campus, spending a total of $121,832–$166,420 for course materials. Enrollment numbers indicate that approximately 300 students complete this course each year on the Dahlonega campus, spending $58,200 -

$79,500 annually. This cost would be completely eliminated.

Timeline:

Date	Action
June 5, 2017	Kickoff meeting attended by Marnie Phipps and Patty Wagner
Aug. 21, 2017	Draft of unit resources completed
Aug. 21, 2017 - Dec. 15, 2017	Wagner and Phipps each implement developed resources in MATH 1101 course. Informal reflections and assessment of tasks and course materials are noted. Weekly meeting are held to address concerns and make adjustments to the resources. Content and disposition assessments and focus interviews that align to goals 2 and 3 are given. Modifications to measurements are made before implementation in spring semester.
Jan. 7, 2018	Final adjustments to unit resources completed. Control section of MATH 1101 identified. IRB approval for project assessment obtained. Qualitative assessment of Goal 1 completed.
Jan. 8, 2018 - May 4, 2018	Implementation of resources in at least two sections of MATH 1101
Early Jan. 2018	Project status report submitted to ALG
Jan. 2018	Pretests administered to experimental and control MATH 1101 sections. The pretests will evaluate content knowledge and mathematical dispositions. Participants for qualitative assessment identified.
Early May 2018	Content and disposition post-assessments administered and analyzed
Mid-May 2018	Analysis of both qualitative and quantitative measures (dispositions & content knowledge via final exam) completed

End of May 2018	Final project report submitted to ALG. At the request of the departmental curriculum committee, the final report will be shared with them and our department head.
Aug. 2018 and beyond	Share the results of project measures to all UNG mathematics faculty via departmental colloquium and disseminate results at conferences. Update and revise the material over the next 3 years as needed.

Budget:

Dr. Patty Wagner – Compensation for preparation time --$5,000
Dr. Marnie Phipps – Compensation for preparation time -- $5,000
Travel – Kick-off meeting and conference travel -- $800

Sustainability Plan:

Sustainability for UNG
Faculty at UNG utilize Desire 2 Learn [D2L] as an on-line web interface for courses. In the spring of 2018, when the materials become publicly available, we will set up a basic outline of the course in D2L. Currently these are referred to as sandbox courses because any instructor within UNG can copy all components of the course and tailor the materials to suit their students.

Sustainability outside of UNG
We will work with the Nighthawks Open Institutional Repository at UNG to post and upload all the developed resources and materials. Additionally, we will make these resources available through the Georgia Knowledge Repository and the GALILEO Open Learning Materials repository. We will hold two webinars at the beginning of the fall in 2018 and spring of 2019 to orient instructors to these materials. Once per year, we will update and revise the materials as needed for the next 3 years.

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DEPARTMENT OF MATHEMATICS

April 12, 2017

Affordable Learning Textbook Transformation Grant
Review Committee

Dear Committee Members:

I am writing this letter in support of the proposal being submitted to you by Professors Marnie Phipps and Patricia Wagner from my department. I am in full support of this proposal because I believe the proposal has strong merit and because these faculty members are talented faculty members who are well qualified to accomplish the goals of the proposal.

Professors Phipps and Wagner have experience teaching the course that is targeted in the proposal. I am excited at the potential financial savings our students could realize, and I intend to lend full departmental support for the work of this proposal. Since we teach multiple sections of these courses every semester, including summer, the potential sustainability of the project will not be a concern. The expansion of the project to other sections of these classes on our other campuses can be accomplished by working through our existing departmental Curriculum Committee which has representation from faculty on all University of North Georgia campuses.

I am in full support of this proposal, and I hope that you will be able to give the proposal every possible consideration. I would be happy to comment further if you so like.

Sincerely,

John Cruthirds

John Cruthirds, Head
Department of Mathematics
john.cruthirds@ung.edu
706 864-1810

References

Arnold, D., butler, M., Haley, M., Harrow, D., Ives, A., Jackson, S. Kutil, C., Matsumoto, T., Prystowsky, J. M., Olsen, T., Tuttle, D., and Wagner, B. (2007). Intermediate algebra. Available at http://msenux2.redwoods.edu/IntAlgText/.

Mathematics Assessment Resource Service. (2007). Mathematics assessment project. Available at http://map.mathshell.org/index.php.

Meyer, D. (n.d.). 3-act tasks. Available at https://docs.google.com/spreadsheets/d/1jXSt_CoDzyDFeJimZxnhgwOVsWkTQEsfqouLWNNC6Z4/pub?output=html.

National Council of Teacher of Mathematics. (2014). Principles to actions: Ensuring mathematical success for all. Reston, VA: Author.

National Research Council. (2001). *Adding it up: Helping children learn mathematics*. J.Kilpatrick, J. Swafford, and B.Findell (Eds.). Mathematics Learning Study Committee, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.

Phipps, M. & Wagner, P. A. (2017). The hidden curriculum in higher education mathematics modeling textbooks. In T. A. Olson & L. Venenciano (Eds.), Proceedings of the 44th annual meeting of the Research Council on Mathematics Learning (pp. 137–144). Fort Worth, TX.

University System of Georgia/Academic Committee: Mathematical Subjects. (2014). *Math 1101 Outline.* Retrieved from http://www.usg.edu/assets/academic_partnerships_accreditation/committee_docs/documents/Math_1101_Introduction_to_Mathematical_Modeling_Outline_2014.pdf

Affordable Learning Georgia Textbook Transformation Grants

Round Nine

For Implementations beginning Summer Semester 2017

Running Through Spring Semester 2018

NARRATIVE

1.1 PROJECT GOALS

List the goals you are trying to achieve with the transformation, including goals for student savings, student success, materials creation, and pedagogical transformation.

Many non-STEM majors enroll in introductory mathematics modeling courses to fulfill general university requirements for quantitative reasoning. In our experience, many of these students experienced difficulty learning mathematics in the K-12 school setting and their affinity for the subject has been severely diminished. The mathematics modeling course is particularly suited for these students because context allows students to consider mathematics from an intuitive, concrete perspective. Through initial explorations and a focus on multiple representations, and with an eye towards building a mathematical toolbox for problem solving, students may come to realize that mathematics is far more than rules and procedures. Unfortunately, our research suggests that many commercial textbooks do not capitalize on these aspects of a mathematics modeling course (Phipps & Wagner, 2017). Rather, textbooks written for mathematics modeling courses tend toward more traditional presentations; one in which mathematics is presented as a way to understand the world rather than the other way around.

Our goals for this project are four-fold. First, we desire to design a course and identify course materials that align with National Council of Teachers of Mathematics' [NCTM] (2014) effective teaching and learning practices. These practices were developed through research in an effort to ensure mathematical success for ALL students. Rather than relying on a traditional textbook format, we will identify and compile effective student and instructor resources that are freely available. Second, our goal is for students in mathematics modeling courses to show progress in productive dispositions (National Research Council, 2001). Specifically, students will find mathematical success attainable, recognize the value in perseverance and productive struggle, perceive mathematics as a discipline involving reasoning and sense making, and view mathematics as a relevant tool for problem solving. Third our goal is to have students demonstrate content knowledge growth of the essential components of this course as designated by the University System of Georgia [USG] syllabus for mathematics modeling. Students' growth will be demonstrated both conceptually and procedurally in contexts designed to make sense of worldly phenomena. Last, we want to reduce the financial burden to students by using publicly available resources. Ultimately, this grant will provide an opportunity to incorporate current research in teaching and learning practices to engage students in new and innovative ways, while reducing students' cost to zero.

1.2 STATEMENT OF TRANSFORMATION

- *Describe the transformation.*

We intend to transform our institutional mathematics modeling course from a textbook driven, traditional lecture approach to one that encourages and develops students' critical thinking and problem solving. As such, we propose to develop resources for the instructor's use as much as the students'. Our materials will suggest ways to ensure that important mathematical concepts are highlighted through in-class work and discussions. We will also suggest websites students can visit for extra practice or information.

Our mathematics modeling course will consist of classwork in the form of high cognitive demand tasks, on which students will work in teams. We may create some of these tasks, but many will be intentionally selected from publicly available resources, including OERs, mathematics-specific organizations, and interested individuals (for example, Arnolds et al., 2007; Mathematics Assessment Resource Service, 2007; and Meyer, n.d., respectively). These tasks will introduce topics from the USG syllabus for mathematics modeling.

For each topic, we will provide a task—or a link to a publicly available task, depending on copyright and licensing requirements—as part of an instructional packet. For each of these tasks, we will create lesson resources that identify appropriate scaffolding questions for students who are struggling. Additionally, we will identify common methods students might use to solve the task and suggest a sequence of presentation for the follow-up whole class discussion. Our lesson resources will suggest connections that can be made between methods and representations and ways to highlight the relevant mathematics. We will also identify appropriate follow-up practice and free technology apps (e.g.www.desmos.com and GeoGebra) that can foster students' connections between algebraic, graphic and numeric representations. These free technology applications will replace the currently required graphing calculators and are arguably superior to calculators for exploration and developing connections. In this technological age, we anticipate that student's will be able to use smartphone capabilities to access applications for spreadsheets, graphing data and functions, and various calculations. Students without a smartphone will be able to rely on campus computers. We will substitute our current WebAssign online practice with in-class work, projects, individual paper-and-pencil practice problems, and online practice websites.

- *Identify stakeholders affected by the transformation.*

Initially, the transformation has the potential to impact students taking this core class with and instructor who has adopted our materials. We will offer our resources to all instructors of MATH 1101 or similar modeling courses; instructors will gain full access to lesson plans, in-class tasks, Power Points, sample projects, tests, etc. beginning spring 2018.

- *Describe the impact of this transformation on stakeholders and course success.*

Beyond the savings in material costs generated by students, we believe that this

innovated course will impact students' view of mathematics as a discipline and their own affinity for it. We also believe that we will see increased student success, particularly among student groups who have traditionally struggled with mathematics. These groups include non-traditional students, first-generation students, and those who have been enrolled in remedial or support courses.

- *Describe the transformative impact on the course, program, department, institutions, access institution, and/or multiple courses.*

We consider this project an ongoing effort to transform the mathematics modeling course. ALG funds will allow for an intensive initial effort in restructuring the course; however, we intend to continue making modifications and adjustments as a result of program assessments. As we compile evidence supporting the positive impact of our resources and methods, we expect more and more faculty across UNG's five campuses to adopt them. Our department has launched an open discussion about OERs and their role in teaching and learning. This project will serve as evidence of their effects. We anticipate this course restructure will have a positive impact on students who might otherwise have struggled to meet institutional quantitative requirements.

We will also share our results and materials at state conferences such as the USG Teaching and Learning Conference hosted in Athens, GA or national conferences such as the Research Council on Learning Mathematics. Exposure through these modes of professional development creates a possibility for impacting mathematics modeling courses within and outside the state of Georgia.

1.3 TRANSFORMATION ACTION PLAN

The ALG team consists of Patty Wagner and Marnie Phipps. We each earned a doctorate in the field of mathematics education and train future secondary mathematics teachers at our institution. Our pedagogical choices are informed by the literature about how students learn mathematics and how to ensure mathematical opportunity for ALL students. Our interest in this project stems partly from the findings of our recent analysis of mathematics modeling textbooks used in the state of Georgia (Phipps & Wagner, 2017). Noting that these textbooks largely lack characteristics of NCTM's (2014) effective teaching and learning practices, we brainstormed ways in which the course could be restructured to capitalize on these practices. We noted that excellent resources are already publicly available but need to be identified, modified for the MATH 1101 course, and supplemented with pedagogical decisions. To that affect, our action plan follows.

We will identify our resources and create initial instructional plans prior to the fall 2017 semester. We will begin with our department's syllabus for the course as written, but will propose changes as needed. We will refer to our department head, John Cruthirds, and the USG Academic Committee's (2014) *Math 1101 Intro to Math Modeling Outline* to ensure any proposed changes meet departmental approval and USG guidelines. Following NCTM's (2014) practices of effective teaching and learning, we will establish unit goals and objectives, with an eye towards what mathematics is to be learned, why is it important, how it relates to prior mathematical learning, and to what mathematical ideas we are heading. We will then create or search publicly available resources for tasks that "promote reasoning and problem solving" (NCTM, 2014, p. 17) and that will serve to meet the unit objectives. As mentioned early in this proposal, course materials under consideration may originate from Mathematics Assessment Resource Service (2007) or Meyer (n.d.) for classroom engagement activities and Arnolds et al. (2007) as practice problems for students.

We are seeking materials which contain wide entry levels and which allow for individual expression and representation. Students will start with their personal prior knowledge base and expand mathematical learning through scaffolding questions. Scaffolding questions are typically open-ended and designed to help a student focus on the relevant mathematics without taking over the student's thinking (NCTM). We will then describe how a follow up presentation can connect the various solution strategies in ways that move students toward a conceptual understanding of the relevant mathematics. By connecting strategies and representations to their own experiences, students can develop an understanding from which they can build procedural fluency (NCTM). Our description of the follow-up whole class discussion will include suggestions for sequencing of strategy presentations, open-ended questions to elicit connections between strategies or representations, and ideas for ensuring that the relevant mathematical ideas are emphasized. Finally, we will identify practice problems to help build procedural fluency, projects that make use of the mathematical ideas, and/or links to online student resources.

In fall 2017, as instructors of record, we will each implement the designed course in a single section of MATH 1101. After each instructional session, we will reflect separately on its effectiveness and note changes that should be made. We will meet with each other weekly to compare our qualitative assessments of each task and make appropriate adjustments or modifications. In spring 2018, we will designate a control section of MATH 1101 that will retain the original departmental design. Phipps and Wagner will each teach a transformed version of MATH 1101 using our developed resources. We will conduct our formal assessment of the project during this semester.

The resources we develop will be compiled as lesson plans, tasks, instructional PowerPoint presentations, links to student practice and resources, etc. for each unit in the mathematics modeling course. As such, they will represent a more complete resource for instructors than the typical textbook. We will organize these resources to maximize ease of use by instructors and make them available electronically to all UNG instructors through the institution's shared U drive in fall of 2017. Additionally, we will make the resources publicly available to the University of North Georgia's Nighthawks Open Institutional Repository beginning spring of 2018. At the completion of the project the resources will also be available through the Georgia Knowledge Repository and the GALILEO Open Learning Materials repository. In the following academic year, introductory webinar's will be offered each semester to instructors using these materials.

1.4 QUANTITATIVE AND QUALITATIVE MEASURES

Goal 1 is to design a course and course materials that align with NCTM's (2014) effective teaching and learning practices.

Phipps and Wagner (2017) have established qualitative criteria to determine the extent to which curriculum materials meet NCTM's guidelines. Using this tool we will measure materials created and designed for Math 1101. This will occur before materials are released for public use the start of the semester in January 2018.

Goal 2 is for students in mathematics modeling courses to show progress in productive dispositions.

We will create or find an appropriate Likert-scale online survey with questions about views of math, self-efficacy, and dispositions. Surveys will be administered both pre- and post-semester. Additionally, we will conduct short interviews with two focus groups of up to 4 students on their experiences with mathematics and the course. Surveys and focus group interviews will occur fall and spring semesters.

Goal 3 is to have students demonstrate content knowledge growth

We will administer pre- and post-tests to measure student growth for specific course objectives to all students in the experimental Math 1101 course and conduct a matched pairs analysis to measure student growth. The pre-test will also be administered to the students in the control course to test for significant differences in incoming ability levels. We will attempt to measure at-risk subgroups within our population; however, small sample sizes may limit the number and kinds of subgroups analyzed. Possible subgroups may include non-traditional students, first-generation students, and those who have been enrolled in remedial or support courses. Content testing will occur in both fall and spring semesters.

Goal 4 is to reduce the financial burden to students by using publicly available resources.

In the past two academic years, 628 students have taken this course on the Dahlonega campus, spending a total of $121,832–$166,420 for course materials. Enrollment numbers indicate that approximately 300 students complete this course each year on the Dahlonega campus, spending $58,200 - $79,500 annually. This cost would be completely eliminated.

1.5 TIMELINE

June 5, 2017: Kickoff meeting attended by Marnie Phipps and Patty Wagner.

August 21, 2017: Draft of unit resources completed.

August 21, 2017 – December 15, 2017: Wagner and Phipps each implement developed resources in MATH 1101 course. Informal reflections and assessment of tasks and course materials are noted. Weekly meetings are held to address concerns and make adjustments to the resources. Content and disposition assessments and focus interviews that align to goals 2 and 3 are given. Modifications to measurements are made before implementation in spring semester.

January 7, 2018: Final adjustments to unit resources completed. Control section of MATH 1101 identified. IRB approval for project assessment obtained. Qualitative assessment of Goal 1 administered.

January 8, 2018 – May 4, 2018: Implementation of resources in at least two sections of MATH 1101.

Early January: Project status report submitted to ALG.

January 2018: Pretests administered to experimental and control MATH 1101 sections. The pretests will evaluate content knowledge and mathematical dispositions. Participants for qualitative assessment identified.

Early May 2018: Content and disposition post-assessments administered and analyzed.

Mid-May: Analysis of both qualitative and quantitative measures (dispositions & content knowledge via final exam) completed.

End of May 2018: Final project report submitted to ALG. At the request of the departmental curriculum committee, the final report will be shared with them and our department head.

August of 2018 and beyond: Share the results of project measures to all UNG mathematics faculty via departmental colloquium and disseminate results at conferences. Update and revise the material over the next 3 years as needed.

1.6 BUDGET

Dr. Patty Wagner – Compensation for preparation time --$5,000

Dr. Marnie Phipps – Compensation for preparation time -- $5,000

Travel – Kick-off meeting and conference travel -- $800

1.7 SUSTAINABILITY PLAN

Sustainability for UNG

Faculty at UNG utilize Desire 2 Learn [D2L] as an on-line web interface for courses. In the spring of 2018, when the materials become publicly available, we will set up a basic outline of the course in D2L. Currently these are referred to as sandbox courses because any instructor within UNG can copy all components of the course and tailor the materials to suit their students.

Sustainability outside of UNG

We will work with the Nighthawks Open Institutional Repository at UNG to post and upload all the developed resources and materials. Additionally, we will make these resources available through the Georgia Knowledge Repository and the GALILEO Open Learning Materials repository. We will hold two webinars at the beginning of the fall in 2018 and spring of 2019 to orient instructors to these materials. Once per year, we will update and revise the materials as needed for the next 3 years.

1.8 REFERENCES & ATTACHMENTS

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