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Application Summary

Competition Details

Competition Title:	Textbook Transformation Grants, Round Fifteen (Fall 2019 - Fall 2020)
Category:	University System of Georgia
Award Cycle:	Round 15
Submission Deadline:	09/16/2019 at 11:59 PM

Application Information

Submitted By:	Cathy Hakes
Appplication ID:	3555
Application Title:	482
Date Submitted:	09/17/2019 at 8:29 AM

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Application Details

Proposal Title

482

Requested Amount of Funding

$10,800

Priority Category (if applicable)

Upper-Level Courses (3000+)

Final Semester:

Fall 2020

Course Title(s)
Software Development II

Course Number(s)
ITEC 3870

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Additional Team Members (Name and email address for each)

Sponsor Name
Joseph Sloop

Sponsor Title
Interim Dean

Sponsor Department
School of Science and Technology

Average Number of Students per Course Section Affected by Project in One Academic Year
16

Average Number of Sections Affected by Project in One Academic Year
4

Total Number of Students Affected by Project in One Academic Year
62

Average Number of Students Affected per Summer Semester
0

Average Number of Students Affected per Fall Semester

38

Average Number of Students Affected per Spring Semester

24

Original Required Commercial Materials (title, author, price, and bookstore or retailer URL showing price)

(1) Title: "Software Engineering: A Practitioner's Approach", 8th Edition (recommended textbook).

Author: Roger S Pressman, Bruce Maxim

Price: $174

URL from campus bookstore: https://ggc.bncollege.com/shop/ggc/textbook/software-engineeringpracappr?sectionId=91175999&displayStoreId=54053&ionList=&booksAddedforSec=&fromTBList=true

(2) Title: "Code Complete: A Practical Handbook of Software Construction", 2nd Edition (recommended textbook).

Author: Steve McConnell

Price: $55

URL from campus bookstore: https://ggc.bncollege.com/shop/ggc/textbook/code-complete-600000327413?sectionId=91175999&displayStoreId=54053&ionList=&booksAddedforSec=&fromTBList=true

(3) Title: "Clean Code: A Handbook of Agile Software Craftsmanship" 1st Edition (recommended textbook).

Author: Robert C. Martin

Price: $50

URL from campus bookstore: https://ggc.bncollege.com/shop/ggc/textbook/clean-code-600000505529?sectionId=91175999&displayStoreId=54053&ionList=&booksAddedforSec=&fromTBList=true

(4) Title: "Getting MEAN with Mongo, Express, Angular, and Node" 1st Edition (recommended textbook).

Author: Simon Holmes

Price: $45

URL from campus bookstore: https://ggc.bncollege.com/shop/ggc/textbook/getting-mean-with-mongoexpress-600007977097?sectionId=91175999&displayStoreId=54053&ionList=&booksAddedforSec=&fromTBList=true

NOTE: If you are redirected to the GGC bookstore, please choose Fall 2019, ITEC 3870 Section 01.

Original Total Cost per Student

$324

Post-Project Cost per Student

$0

Post-Project Savings per Student

$324

Projected Total Annual Student Savings per Academic Year

$20,088

Using OpenStax Textbook?

No

Project Goals

In an article by Gutenberg Technology [1], it was stated that, "A growing number of college students are saving money by not buying the textbooks required for their courses. Some buy secondhand books instead…**while other students simply find similar content online and make use of that instead.**" Such was the case in the ITEC 3870 course taught by the project team.

ITEC 3870 is currently taught by only two professors (the writers of this proposal), Drs. Cengiz Gunay and Anca Doloc-Mihu. At this time, the course has no <u>required</u> textbook because of multiple reasons. First, in the Information Technology (IT) field, the knowledge is changing so fast that any book becomes old very quickly whereas up-to-date materials simply exist online. Therefore, students are reluctant to or do not buy textbooks; instead, they prefer to follow the presentation slides we used in the classroom and to search the internet for additional resources. But academic success suffers when students do not purchase a textbook, especially among students with a greater need for extra materials to improve their course understanding. The second reason for removing the textbooks is because the teaching faculty and the students have found the formerly required textbook to be outdated, repetitive, based only on reading and lecture style, and did not include any practical materials that students could learn via examples and could practice the new concepts. Since almost none of our students were purchasing the main textbook, we (out of desperation) recently changed our syllabus to list several <u>recommended</u> textbooks instead because no single source was sufficient.

To provide students with good software skills, we relied on various materials gathered from these four different books and online websites. However, this move confused the students and their success suffered. Hence, we believe that it is urgent to provide students with a well-organized, free online textbook that includes all the necessary high-level software skills in one place, presented uniformly, along with examples, and that offers the possibility for the students to practice their skills right away via a real-world project-based learning approach. ALG is giving us the opportunity to put materials together from multiple resources and create such a novel resource. Thus, the purpose of this project is to provide students taking the ITEC 3870 Software Development II course with an online textbook that includes all the necessary updated and practical materials for the class that is at no cost to them.

The specific goals of the project are:

A. **Improve student success in the upper level Software Development track courses by creating on-line, customized, and organized course materials focused on up-to-date software development industry practices.**

The Georgia Gwinnett College (GGC) degree program in Information Technology (IT) has a Software Development (SD) concentration, which offers a final sequence of three courses for its junior and senior undergraduate students:

1.) ITEC 3860 Software Development I (SD I) – 75 students average per year
2.) ITEC 3870 Software Development II (SD II) – 62 students average per year
3.) ITEC 4860 Software Development Project (SDP - final capstone course) – 55 students average per year

In this ALG application, we could have targeted the first course in this sequence, but we decided on creating a book for SD II because there is an urgent need for it. The first course, SD I, already has a fixed syllabus that takes the students through introductory material. But the second course, SD II, being the last course before the capstone project course, needs to fill in large gaps to prepare students for the workforce. It is not appropriate to simply follow a single textbook in this course, but instead cover a diverse set of materials from multiple resources to bring students to industry standards. The new materials for SD II will overlap with some of the modules in SD I and SDP and be beneficial for those courses, creating a synergy. Already some modules that we had developed in SD II (e.g., Github exercises and lectures) are being employed in the SD I course by two instructors and in the SDP course by one instructor. Therefore, this ALG application will create required materials for SD II and ancillary materials for SD I and SDP. We plan to properly revise and refine the materials for SD I and SDP courses in subsequent Mini Grant applications to ALG by reaching out to the instructors who regularly teach these courses.

The SD II course uses materials from several textbooks:

1.) Roger S Pressman, Bruce Maxim. "Software Engineering: A Practitioner's Approach" 8th Edition in 2014, originally required textbook [2] - has 39 chapters and it is now recommended for SD II.
2.) Steve McConnell "Code Complete: A Practical Handbook of Software Construction" 2nd Edition in 2004 [3] - has 35 chapters within 7 parts and recommended for SD II.
3.) Robert C. Martin "Clean Code: A Handbook of Agile Software Craftsmanship" 1st Edition, 2008 [28] – has 17 chapters and recommended for SD II.
4.) Simon Holmes "Getting MEAN with Mongo, Express, Angular, and Node" 2nd Edition, April 2019 [29] – has 12 chapters and recommended for SD II.

There are several problems regarding the use of these books.

1.) Only parts of the books are ever used in class

The course covers at most one third of its textbook's contents in one semester. Many of the chapters are never touched. For instance, the textbook by Pressman & Maxim [2] goes into very deep historical detail of legacy systems, which is not beneficial to our undergraduate students. Moreover, the Software Development field requires knowledge from many textbooks, such as the four suggested readings listed above. As these books are hard copies from different vendors, there is no way to customize their chapters into single books fitted for each of our course needs.

2.) Textbooks' contents are not up to date, therefore missing important new concepts, technologies, and emerging paradigms

The main textbook [2] is 5 years old and the oldest one is 15 years old. Moreover, none of the books can keep up with the constantly changing technologies required for software development. Lastly, only one book [29] covers important concepts and tools that are in our course syllabus and are highly used in IT industry. But others are still missing, such as Github and Jira for which we still must provide customized lessons and exercises.

3.) Textbooks are not aimed at practice

When technology is changing at the pace it is today with the amount of online material far surpassing any printed textbook, one must consider if the textbook knowledge is sufficient to prepare students for their careers. In addition to memorizing concepts, students also need to practice software development via practice projects. None of these books provides class design for project-based learning [12].

Our proposed solution to these issues is to provide a flexible free online repository of materials that can be customized and updated every semester. Moreover, collaborators from other college campuses can make their own versions based on our materials. The learning materials we plan to create will cover all the knowledge and skills students need to develop professional software applications using different tools, and will provide guidelines for instructors as well. Therefore, there will be no need for students to purchase the required and recommended textbooks and other materials. The customized free online textbook and materials will be created specifically to help SD students at junior/senior level improve their academic success.

B. **Improve student outcomes oriented towards the Software Development job market by designing course materials customized around a real-world client-based project to provide students with practice.**

The content in the current textbooks is focused on generic advice on how to develop different types of software with different methodologies without a systematic and quantifiable project development exercise. Instead, our course materials are focused on a real-world project developed using an Agile methodology. We will provide setup guides for instructors to conduct their own course projects. By using the project-based online course materials, students will have the opportunity to design and implement a real software application mimicking the entire Software Development (SD) process that one encounters in a professional environment. The process must also be quantifiable and measurable to enable engineering improvements of the process. Using a process tracking software during the course allows students to practice and learn industry tools designed for this purpose. According to the latest State of the Agile Report [7], the most commonly used tool for tracking Agile-style software development is Jira [6]. Therefore, we include practical lessons on Jira in our course. We believe this pedagogical transformation will fill the gap of textbook knowledge and real-world application and in return improve the student success rate on getting a SD job.

C. **Eliminate student expenses in textbook purchases.**

The price of the textbooks is also an obstacle to student learning. The recommended textbooks for our SD II course are expensive, having a price of $111 at our college bookstore in the cheapest condition (renting a digital or used copies). Buying new copies of all would cost $324. The recommended readings are useful because they provide the additional skills and knowledge more than any one textbook can provide. Students usually wait to buy or do not purchase the textbooks and try to rely on course notes, which do not provide enough explanation. A significant portion of our students struggle with these courses and have low class performance. In fall 2018, roughly 25% of our 33 SD II students received DFW grades. Part of the cause may be their inability to obtain the classroom resources they need to gain the knowledge, skills, and training they need to be academically successful — something that we, as instructors, can assist them with through the ALG Textbook Transformation grant, and we will assess whether any improvements will be achieved.

The three SD sequence courses ITEC 3860 SD I, 3870 SD II, and 4860 SDP are mandatory in our SD concentration, which is the largest of the five IT concentrations at GGC. A total of 192 students annually takes all three SD courses,

and this number is expected to grow at a steady rate. SD II has 62 students annually. SD has consistently been the largest concentration between 2013 and 2017, with a growth of 75% as compared to the overall growth of 70% over all IT concentrations [22], which is higher than the national average because of GGC's fast initial growth as a young institution. However, the importance of the IT field is expanding nationally. The Bureau of Labor Statistics (BLS) estimates a 24% growth in the SD workforce between 2016 - 2026, faster than the average for all occupations [19]. Even though the total number of students we teach in this course is on average modest, there is an upward trend based on incoming software development concentration students. The enrollment in first sequence course, Software Development I, has increased by 10 students between 2018 and 2019. Therefore, we anticipate adding more sections of next sequence SD II course in the future.

D. **Share the learning materials with other USG campuses to benefit more students.**

As an Upper-Level Campus Collaborations proposal, we aim to provide materials that could be adopted by other institutions. Software development is a popular field and schools in the area have different courses for teaching it. We have identified the following courses that offer a similar content and that can benefit from our proposed materials:

1.) University of Georgia (UGA) CSCI 4050/6050 Software Engineering
   http://www.cs.uga.edu/courses/content/csci-40506050
2.) Georgia Institute of Technology (GA Tech) CS 6300: Software Development Process (Software Engineering: Concepts and Practice) http://www.omscs.gatech.edu/cs-6300-software-development-process
3.) Georgia State University (GSU) CSC 4350 Software Engineering
   https://catalog.gsu.edu/undergraduate20182019/computer-science/
4.) Kennesaw State University (KSU) has a Bachelor of Science major in Software Engineering (https://ccse.kennesaw.edu/undergraduate/choosing-a-major.php), which includes the following relevant courses: SWE 3313 Introduction to Software Engineering, SWE 3623 Software Systems Requirements, SWE 3633 Software Architecture & Design, SWE 4663 Software Project Management, SWE 4713 SWE Application Domain, SWE 4724 Software Engineering Project

In the first phase of this project, we plan to focus on only the courses offered at GGC and produce online materials that can be further extended. Once the first phase is completed, we plan to notify instructors of the above courses, seeking for collaboration opportunities.

As opposed to providing materials inside an institution-locked learning management system (LMS), such as the Desire2Learn (D2L) Brightspace used at GGC, we will make the created learning materials available on outside public websites and repositories that are freely accessible to all the USG faculty and further (such as Github [15]). This open-source textbook model encourages sharing and further improvement by others, and it is true to the mission of ALG. The materials provided can be used as a replacement to their current textbooks or supplement teaching materials. This will increase the student impact of this proposal to a much larger scale than that offered at GGC.

Statement of Transformation

In an August 7, 2018, Medium.com article [17], Jessica Williams stated that software development ranks as the number 1 job in the U.S. In fact, CIO, a leading digital magazine for IT executives and decision-makers, listed developers (web, software, and mobile) as one of the top 13 in-demand tech jobs for 2019 [18]. The Bureau of Labor Statistics also projected employment for software developers to grow 24% into 2026 [19]. But this growth may not be enough to satisfy the need. In an open letter by the Computer Science Education Coalition [20], signed by American leaders in business, education, and government, including twenty-eight governors, estimate that there are currently 500,000 open computing jobs in every sector to be filled, but there are only 50,000 computer science/information technology graduates per year. In the state of Georgia, according to the Georgia Department of Labor, Computer & Math related job openings are estimated to grow by 16,030 by 2026 according to the Workforce Trends publication [21]. This remarkable employment trend is significant for GGC's IT students, especially that in the School of Science and Technology. **IT students represent the second largest group of first-generation students, the largest group who receive financial aid, and the largest group from ethnic groups who are traditionally under-represented in high-paying STEM fields. Through this project, GGC will have the ability to ease the students' financial burden and to provide them with appropriate, quality tools to pass their classes and enter the job market sooner.**

Information Technology is the most popular major in GGC, with over 10% of students majoring in the field [22]. The major has been successful in the national scene when student competitors received Top School award in 2018 by the USITCC organization [23]. The most popular concentration with 42% of IT major students is Software Development (SD). The course that we target in this proposal is required for students in the SD concentration. The course recommends textbooks that are in the high end of technology books. The total price of the textbooks is $324 as explained in the Project Goals section above [4, 5, 24]. Textbooks are frequently updated, which negatively impacts their resale value. In addition, students must have a powerful laptop computer to take this course, which adds an additional $350 or more financial burden. Therefore, having no-cost books in this course will significantly decrease the financial burden on IT students. This is important because then the students will need to spend less hours working jobs outside of school.

As knowledge in the SD field is very diverse and changing constantly, up-to-date instruction requires integrating information from multiple sources. Despite frequent updates, most of the available textbooks are outdated very quickly and fail to include all aspects that an instructor would like to convey in one course. For instance, the SD I course relies on object-oriented software development textbook [24] that focuses solely on Java, which is ranked down at 9th place today among most wanted computing languages and it has been losing popularity [25]. In the SD II course, we must expose students to more languages. There are several upcoming languages and frameworks that the students do not get exposed by using such obsolete textbooks. It is true that many colleges still focus on a Java-only curriculum, but a less-known institution like GGC requires its students to distinguish themselves from graduates of other more-known schools. Exposing students to a variety of computing languages and frameworks would potentially increase their employment chances. Another emerging topic that is missing from the classical textbooks on the topic is the wide scale adoption of Agile Methodologies in the industry. Most of the books focus on older Waterfall Methodologies. There are new books that solely focus on Agile, but that would be yet another textbook to purchase for students. We aim to include a comparison of both methodologies and their pros and cons. Most learning resources for these additional SD topics are abundant online today [8-11], which confuses students as they need a clear structured guidance to navigate them. Many of these resources are publicly accessible, free, or with an open license to use. With our approach to creating materials, we can link to these outside resources easily.

The investigators of this proposal aim at creating new, no-cost materials to replace the costly textbooks, but more importantly, achieving more and better learning outcomes by providing more up-to-date and career-relevant topics in SD courses. Currently, students of the SD courses access presentation materials and resources through the D2L LMS managed by GGC and through the several required and recommended textbooks mentioned above. Our vision of this transformation is to create new materials that will be completely freely accessible, such that they do not depend on GGC's D2L system and are accessible even outside of GGC. This would increase the impact of the proposed materials to reach many more students within University System of Georgia and beyond.

In this proposal, we will start by creating textbook materials for the ITEC 3870 SD II course, which will also be useful for some modules in SD I and SDP courses because of their overlap. By not tying the SD II course to a single specific textbook and reading materials, we also plan on transforming the contents of the course. Instead of a linear lecture course, we propose to create **project-based** teaching and learning course materials, with required theory and concepts provided as needed. The knowledge covered will be focused on building a fully-fledged software development project by the students. This project would entail going through the phases of software development process, requirements gathering, architectural design, implementation, and testing to produce a real-world software product. Project-based learning (PBL) has been known to increase student engagement and performance. PBL is a student-centered pedagogy that involves a dynamic classroom approach, which aims for students to acquire a deeper knowledge through active exploration of real-world challenges and problems [12]. It can be considered an active learning and inquiry-based learning categories. A meta-analysis conducted by Purdue University found that when implemented well, PBL can increase long-term retention of material and replicable skill, as well as improve

teachers' and students' attitudes towards learning [13]. For the software development and engineering fields, it has been shown that real-world projects and case studies increase effectiveness of education [14]. Practical knowledge becomes crucial in preparing students for real-world career path, which has very steep experience requirements for current tools and computer languages. By using the proposed project-based course materials, we believe students will improve class engagement and learning satisfaction, gain experience in working on real-world applications, and improve student success rate in getting a job in the SD field.

Project's transformative impact on course and department

The stakeholders directly affected by the transformation will be approximately 192 traditional and non-traditional undergraduate students annually who are enrolled in the sequence of Software Development courses at GGC. These students are from diverse backgrounds and include underrepresented and underprivileged populations. As such, GGC has been selected as the "#1 most ethnically diverse southern regional college" by the US News & World Report magazine in the last five consecutive years [26, 27].

In the first phase of this project, we are proposing to target materials for the SD II course, which overlap with other two courses. The prerequisite course, ITEC 3860 Software Development I, and the final capstone project course, ITEC 4860 Software Development Project, go over some of the technologies and methodologies of SD II to practice and repeat. Therefore, their students will benefit also from this textbook transformation. It is worth mentioning that the two professors (the writers of this proposal), Drs. Cengiz Gunay and Anca Doloc-Mihu are the sole teachers of this course, SD II, and they are also part of the Software Development Goal Team Committee in the department, therefore they are fully knowledgeable of the SD concentration and departmental needs and requirements. Moreover, Dr. Doloc-Mihu is also teaching the SD I course once a year, and Dr. C Gunay is teaching the SDP course.

The transformation process will simplify the SD course materials and help remove and eliminate the cost of expensive textbooks for students. All materials will be accessible online at no cost and will be organized such that they can easily be updated as the content changes to incorporate the latest SD technology. Students will have access to up-to-date course learning materials on the first day of class.

The project-based learning approach that we plan to take will better engage our students, as they know that every skill they learn in the course will be used to build real-world software. This will help to improve engagement, attendance, and retention. The experience gained from working on a real-world software application will benefit their future career success, which is especially important in a software development career.

Project's transformative impact on institution

The course we selected is required for the Information Technology major students in the Software Development concentration and is an elective for the other IT concentrations at GGC. In completing this project by creating materials for the SD II course, we provide a successful transformational example to the two other similar courses in the SD concentration at GGC: the prerequisite course, ITEC 3860 Software Development I, and the final capstone project course, ITEC 4860 Software Development Project. Both courses can benefit students through a textbook transformation to improve pedagogy and reduce costs. Therefore, the current proposal's success would enable their student's future transformation.

We aspire that the successful transformation through this project with zero textbook cost, better course engagement, and student satisfaction will attract more students to the SD major. The proposed project-based approach strongly supports the mission of GGC "... innovative use of technology and active-learning environments to provide students enhanced learning experiences, practical opportunities to apply knowledge..." We aspire that our course transformation will inspire other areas and disciplines at GGC and the USG at large to adopt/adapt free online textbooks.

Transformation Action Plan

Organization of Current Textbooks versus Proposed Transformed Textbook

Current Textbooks

Roger S Pressman, Bruce Maxim. "Software Engineering: A Practitioner's Approach", 8th Edition.

1. The nature of software

2. Software engineering

3. Software process structure

4. Process models

5. Agile development

6. Human aspects of software engineering

7. Principles that guide practice

8. Understanding requirements

9. Requirements modeling: scenario-based methods

10. Requirements modeling: class-based methods

11. Requirements modeling: behavior, patterns, and web/mobile apps

12. Design concepts

13. Architectural design

14. Component-level design

15. User interface design

16. Pattern-based design

17. Web-app design

18 Mobile-app design

19. Quality concepts

20. Review techniques

21. Software quality assurance

22. Software testing strategies

23. Testing conventional applications

24. Testing object-oriented applications

25. Testing web applications

26. Testing mobile applications

27. Security engineering

28. Formal modeling and verification

29. Software configuration management

30. Product metrics.

Steve McConnell "Code Complete" 2nd ed, 2004

I. Laying the foundation

II. Creating high-quality code

III. Variables

IV. Statements

V. Code improvements

VI. System considerations

VII. Software craftsmanship

Robert C. Martin "Clean Code: A Handbook of Agile Software Craftsmanship" 1st Edition, 2008

1. Clean code

2. Meaningful names

3. Functions

4. Comments

5. Formatting

6. Objects and data structures

7. Error handling

8. Boundaries

9. Unit tests

Simon Holmes "Getting MEAN with Mongo, Express, Angular, and Node" 2nd Edition, April 2019

1. Setting the baseline

2. Building a Node web application

3. Adding a dynamic front-end with Angular

4. Managing authentication and user sessions

Proposed Transformed Textbook

Our proposed book is as follows:

1. Software engineering process: (a) Process models, (b) Software architectures, (c) Web-app technologies
2. Agile Development: (a) Principles, (b) Scrums, (c) Kanban
3. Requirements in Agile: (a) Client meeting, (b) Requirements, (c) Teamwork, (d) Communication
4. Version Control: (a) Github, (b) Markdown language
5. Project Management with Jira
6. Creating high-quality code: (a) Interview questions, (b) Common techniques, (c) Performance
7. Web-apps: (a) Architectural design, (b) TypeScript, (c) JavaScript, (d) CSS and HTML, (e)Angular or React
8. NoSQL databases: (a) JSON, (b) MongoDB, (c) Firebase, (d) Couch and pouch
9. Full stack architecture: (a) Angular, (b) MEAN, (c) MERN, (d) Ionic framework
10. Advanced Web-app concepts: (a) Bootstrap, (b) Heroku, (c) Amazon Web Services
11. Project design and management: (a) Phase 1: Start, gathering requirements, team, mockup, (b) Phase 2: Analysis, design, implementation, testing, (c) Phase 3: Bug fixes, testing, deliverables

12. Legal issues in software development: (a) Intellectual property, (b) Licensing

A. The identification, review, selection, and adoption/adaptation/creation of the new course materials

In this phase, the new course materials will be identified and created based on course objectives (with planned adjustments, see below) and student learning outcomes of the ITEC 3870 Software Development II course. The course materials will be focused on the process of building a real-world software development application, and most of them will be produced by using publicly available resources.

The primary resources we plan to include in the new materials are shown above. For each of the chapters, we will provide the following: lessons, example practice, hands-on assignments, all customized to include a beginner, intermediate, and advanced version.

We plan to provide faculty teaching a SD II course with a guideline on how to create an Agile-style project-based classroom environment, including:

- selecting external clients,
- teaching students soft skills and technology skills,
- involving how to work in teams during the software development process,
- leading communication between clients and student teams, and
- presenting project demonstrations and testing sessions at local symposia (e.g. CREATE Symposium and STaRS events at GGC).

B. Preliminary plan to create new materials

The topic list above will be complemented with new materials. **Note that even though the scope of this project may look too big for a team of two faculty, some of these materials already exist (but not in a uniform, easily accessible format) and are used in the current classes.** Our plan is to make them more uniform, general, and accessible. We are also planning to keep the chapter readings as concise as possible as this would make them easy to maintain, and easier for students to read as they are having shorter attention spans to read long materials. Here are some types of materials we will include:

- Custom lessons: supporting theory and concepts provided as needed,
- Custom practical mini hands-on exercises to get students warmed-up to the new technology,
- Custom assignments for some commonly used technologies,
- Custom Agile-style software development environment to be taught and created for students to practice their project-based skills in teams during class and at home via communication tools like Slack and Discord,
- Guidelines and examples on Client-Team communication,
- A gradebook sample that incorporates all the assignments and tests for each iteration of the Agile-style process,
- Guidelines and grading criteria on how to grade the team-based project at each iteration of the Agile process.
- Guidelines on how to pace the semester and schedule different course assignments and development milestones for Agile iterations.

A sample course syllabus will be provided that reflects the transformation. For example, it will include course material information, grade distribution, a tentative course schedule, etc. The syllabus will be modified to reflect the no textbook format. During the semester, a copy of the syllabus will be made available on D2L. A link to the website holding all new course materials will be provided on D2L.

The hands-on assignments and the team project will be graded components, with the project having the biggest weight. Each Agile iteration of the project will have a component in the gradebook. The contents covered in the course will be mapped to the modified course objectives.

We aim for this pedagogical transformation to fill the gap between textbook knowledge and real-world application and in return improve student success rates on getting a SD job.

C. Curriculum redesign needed for material transformation

We will be adjusting the course outcomes to reflect the newly transformed course contents and the up-to-date, according-to-industry-standards materials. We will add assessment outcomes for source code tracking using version control systems, project management and development topics, and Agile software development.

Team members' roles

Each team member will have full control over their own modules, but will collaborate to create coherent course contents.

Team member: Cengiz Gunay, Assistant Professor of Information Technology, as a subject matter expert and instructional designer, will:

- Identify and create new course material modules independently.
- Oversee the entire transformation process.
- Select and develop study material for all iterations of the project.
- Develop hands on activities.
- Complete and analyze all grade/survey related data for the course.
- Submit an IRB application to collect the survey and archival grade data.
- Develop guidelines on how to establish connections with external clients.
- Lead the process of development of custom course materials.

Team member: Anca Doloc-Mihu, Assistant Professor of Information Technology, as a subject matter expert and instructional designer, will:

- Create new course material modules independently including developing lecture notes/course PPT slides.
- Identify online free complementary reading materials/tutorials/video clips for each course topic.
- Select and develop study material for all iterations of the project.
- Develop hands on activities.
- Set up and maintain the website course material.
- Set up and maintain the proposed gradebook template (compatible with D2L) for this project.

Here is a breakdown of PI assignment for the major topics covered in the transformation:

- Introduction to Agile-style project – organizing content, lecture notes, practical guidelines, active learning assignments, practical concerns, project application [Dr. Doloc-Mihu]
- Introduction to complex software development projects – organizing content, lecture notes, practical guidelines, active learning assignments, practical concerns, project application, client-team introductions, project selection guidelines [Dr. Gunay]
- Main materials per technology – organizing content, lecture notes, practical guidelines, active learning assignments, practical application to project: Github, Markdown language, JIRA [Dr. Gunay]Angular 6, JSON, MEAN [Dr. Doloc-Mihu]

Plan for providing access

The new course materials will be hosted online, on a freely available portal, such that students and faculty from the entire USG system will have free access to materials any time. We will put links to all our materials on GGC's D2L, but we will not lock it into D2L because we want to make it truly available to everyone, and not just to GGC community. A problem with GGC's D2L is that **even faculty at GGC may not know that course materials exist** because we cannot see other faculty's D2L unless specifically given permission. In addition, old courses can be easily forgotten. Instead, we will provide fully open, online materials that can be accessed by anyone freely without locking under a specific school's portal (e.g., on Github.com). All students who take this course will have free access to the materials on the first day of class and throughout life.

This website will be used to post all the course materials, announcements, assignments, and instruct students were to submit their homework. No grades or student information will be posted on the website. Students will take tests and quizzes on GGC's D2L, where they will have their grades posted privately.

We will use various online software development services for students to post their products for homework and projects (since D2L does not provide this function). Note that students can register for free accounts on these web sites (e.g., JIRA, GitHub, BitBucket, etc.).

Quantitative & Qualitative Measures

Questionnaires will be administered using a surveying tool approved by the IRB committee at GGC. Data analysis will be done via Excel sheets.

The PIs will collect the data below for each goal. Quantitative data will be collected from faculty who are conducting courses using the newly proposed materials. For example, they will be asked to evaluate statements on a 1-5 Likert-scale from strongly disagree to strongly agree. See below for specific data items for each goal.

Qualitative data will be collected by surveying faculty, students, and project clients. There will be open-ended questions to get feedback. The data will be collected at the end of the semester and compared with similar data from prior semesters when this material was not available. The comparison result will be used to evaluate the efficacy of the course materials in improving student success.

GOAL A: Improve student success in ITEC 3870 (Software Development II) by creating on-line, customized, and organized course materials focused on software development industry practices.

Qualitative Measure, Methods, and Tools

Open-ended questions will be asked:

- How can we improve the new course material?
- What would be one thing that can be added to the course material?
- Other comments or suggestions about this course?
- How did the availability of no-cost online textbook and materials help improve your learning?

Quantitative Measure, Methods, and Tools

We will administer a student survey that will assess students' responses (Strongly disagree/Agree) on the following statements.

- The materials clearly explained concepts. The materials are useful to learn the concepts.
- The materials include enough exercises and examples to help me learn the concepts.

We will collect data on course success as required by ALG instructions and compare it to previous data from the course to check for improvements in the following:

- Retention rate in the course
- Passing and failing rate
- Drop and withdraw rate
- Percentage of students getting As, Bs, Cs, Ds, Fs, and
- Percentage of students achieving student learning outcomes.

GOAL B: Improve student outcomes oriented towards the Software Development job market by designing course materials customized around a real-world client-based project to provide students with practice.

Qualitative Measure, Methods, and Tools

Open-ended questions will be asked to the students:

- How can we improve our project-based learning approach?

We will follow up with students to learn about their job application experiences and quality of the job they found (if available) in the SD industry.

We will also ask external clients who are involved with student project the following survey:

- Comments on satisfactory student progress towards the software product

Quantitative Measure, Methods, and Tools

We will administer a student survey that will assess students' response (Strongly disagree/Agree) on the following statements:

- Project-based course materials are very important to learn and practice SD skills.
- I learned all the knowledge and skills needed to build a software project.
- The team-based project learning experience was useful. The team-based project helped me build my communication skills, and my teamwork skills.

We will collect data on:

- Source code progress metrics on JIRA, Github, etc.
- Quantitative metrics listed in Goal 1 would also apply here.
- Follow up with students to measure the time (in months) it took to get a job in the SD industry.

GOAL C: Eliminate student expenses in textbook purchases.

Qualitative Measure, Methods, and Tools

Open-ended questions will be asked:

- How much did you spend on course materials?
- Did the availability of No-Cost-to-Students Learning Materials help improve your success in the course?
- What were the challenges of using the No-Cost-to-Students Learning Materials?

Quantitative Measure, Methods, and Tools

We will administer a student survey that will assess students response (Strongly disagree/Agree) on the following statements.

- The materials are well organized so that necessary information can be found easily.
- The availability of No-Cost-to-Students Learning Materials helped improve my success in the course.

We will collect institutional data to compare with baseline on:

- Course enrollment numbers. Data will be used to determine overall student savings.

GOAL D: Share the learning materials with other USG universities and colleges to benefit more students.

In the first phase on this project, we aim to create the materials for GGC students and post them online for anyone to view. We plan to present our newly developed course materials at conferences. We will share our materials with interested faculty and track their usage and success via a short survey at the end of each semester.

Qualitative Measure, Methods, and Tools

- Survey conference participants for adoption interest and general feedback of usefulness
- Survey faculty who adopted the materials on general feedback on usefulness of materials

Quantitative Measure, Methods, and Tools

- Tracking of number of downloads
- Tracking of locations from where requests originated
- Collaborate with volunteer instructors to track their student numbers

Timeline

Program start: Fall 2019-Fall 2020

Note that the pace of the timeline below may look slow. However, preparation for upper-level courses is more work-intensive and demanding because of its industry/career-focused materials, resources, and activities.

Fall 2019 (Starting in November 2019 after the kickoff)

- Research and identify a publicly and freely accessible website to hold all materials.
- Refine materials to be added into the website
- Prepare and submit IRB proposal for assessment by developing survey questionnaires

Spring 2020

- Start drafting modules for the project-based course materials. These include all reading materials, lecture notes, video clips, exercises, labs, and assignments.
- Start drafting course level materials redesign. This includes quizzes, tests, and syllabus.

Summer 2020

(No teaching assignments – focus on ALG)

ITEC 3870 (Software Development II) is not taught during the summer term at GGC.

- Revise drafts of course materials created and finalize them.
- Revise surveys.
- Identify and prepare for conference submission.

Fall 2020

- Administer the transformed textbook in both sections of ITEC 3870 SD II.
- Student surveys on the transformed textbook as proposed above.
- Analyze data collected. Finish quantitative and qualitative data analysis.
- Compile final report.
- Submit findings at conferences and recruit faculty members to adopt the materials.

Budget

A. Type of Grant: Standard Transformation grant

B. Budget request: $10,800

C. Budget justification

(1) Personnel: $10,000

Dr. Cengiz Gunay: $5,000

Dr. Gunay will select and develop study material for all iterations of the project, develop hands on activities, complete and analyze all grade/survey related data for the course. He will submit an IRB application to collect the survey and archival grade data. He will also develop guidelines on how to establish connections with external clients and will lead the process of development of custom course materials. The requested pay will cover base pay and fringe benefit.

Dr. Anca Doloc-Mihu: $5,000

Dr. Anca Doloc-Mihu will create new course materials, which include developing lecture PPT slides, along with identifying online free complementary reading materials/tutorials/video clips for each course topic. In addition, she will set up and maintain the website course material and the proposed gradebook template (compatible with D2L) for this project. She will build up practice exercises, assignments, and quizzes for all topics of the course. The requested pay will cover base pay and fringe benefits.

(2) Travel: $800

Travel expense: $800 for both PIs to attend the kick off meeting at $400 each. Travel will cover mileage, lodging, and other travel expenses.

Only open source software and web hosting will be used in this project, thus there is no additional spending on software or equipment purchasing.

Total Request: $10,800

Sustainability Plan

The selected SD II course is a required course for the IT major with Software Development concentration at GGC. We target the ITEC 3870 SD II course, which will also indirectly impact students in the SD I and SDP courses because of the overlapping topics. For instance, the Github exercises originally developed for the SD II course is now regularly employed in the SD I course at GGC by various instructors. We plan to properly revise the materials for SD I and SDP courses in subsequent Mini Grant applications to ALG by reaching out to the instructors who regularly teach these courses.

There are two sections of SD II taught each academic semester. We plan to employ the no-cost-to-students materials in both sections for two semesters, so that data from enough number of students are collected. These results will be analyzed as described above and disseminated in local symposia and conference presentations. PIs expect that this project will impact student achievement not only by eliminating textbook and software costs, but most importantly by increasing student engagement in the material inside and outside of the classroom, improving academic performance, which in turn improve retention in this course and student prospects after graduation.

Considering these benefits, the PIs will propose to standardize these resources for future offerings of ITEC 3870, which will also provide ancillary resources for the SD I and SDP courses. Since Dr. Gunay serves as the SD II course coordinator in the School of Science and Technology and both PIs are in SST's Software Development Goal Team, they will be able to promote the adoption of these materials for long-term use. A course coordinator at GGC is the faculty who oversees determining syllabus and textbook assignments for a specific course.

It will also be simple to keep using and maintaining the materials once they are published since they require no paid software. Course materials will be updated periodically by faculty in the Information Technology program to reflect feedback from students and instructors and newly emerging topics in SD in the industry. If there is a need to make significant improvements to the materials or add ancillary materials, we will apply for another ALG grant in the future.

The website will be hosted on a public platform that allows "forking", which means other instructors can make their own customized versions of the materials. This way, many versions of the materials can exist and could help sustainability of the effort.

We plan to prepare scholarly products such as poster presentations and articles in conference proceedings evaluating results of our planned study. We will target a computer science conference with educational research topic, such as the Association for Computing Machinery's (ACM) Special Interest Group on Computer Science Education, or ACM's Richard Tapia Celebration of Diversity in Computing conference.

Acknowledgment

Grant Acceptance

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

September 3, 2019

Re: Affordable Learning Georgia, University System of Georgia
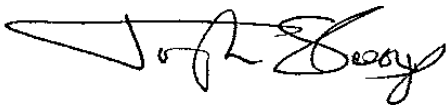
Dear Grant Writing Committee Members,

I am pleased to fully support the "Affordable Learning Georgia Textbook Transformation Grant" grant proposal submitted by two faculty, Drs. Cengiz Gunay and Anca Doloc-Mihu, of the School of Science and Technology at Georgia Gwinnet College (GGC).

The proposed textbook transformation project aims at creating no-cost-to-students learning materials to replace current textbooks for our Software Development course sequence, which is mandatory for the Software Development IT concentration. These new available software development materials will lower the cost of students taking this course, will prepare students better for the software development job market, and therefore will most likely increase interest and success rate in the course. Moreover, the course materials are entirely web-based and publicly available to anyone in the world including the entire University System of Georgia, not only to Georgia Gwinnet College.

Drs. Gunay and Doloc-Mihu have been teaching this course for several semesters. They have the knowledge, skills and experience needed to perform and succeed in the action plan of the grant. If awarded the grant, I will work with them to facilitate and provide necessary resources to ensure the success of the project.

Please let me know if you have more questions or need more information regarding this proposal.

Sincerely,

Joseph Sloop, Ph.D.
Interim Dean, School of Science and Technology
Georgia Gwinnett College

Affordable Learning Georgia

Textbook Transformation Grants, Round Fifteen
(Fall 2019 – Fall 2020)
Proposal Form and Narrative

Applicant, Team, and Sponsor Information

Institution(s)	Georgia Gwinnett College
Applicant Name	Cengiz Gunay
Applicant Email	cgunay@ggc.edu
Applicant Phone #	678-951-9621
Applicant Position/Title	Assistant Professor of Information Technology
Submitter Name	Cathy Hakes
Submitter Email	chakes@ggc.edu
Submitter Phone #	678-407-5875
Submitter Position	Executive Director, Office of Research and Sponsored Programs

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

	Name	Email Address
Team Member 1	Cengiz Gunay	cgunay@ggc.edu
Team Member 2	Anca Doloc-Mihu	adolocmihu@ggc.edu
Team Member 3		
Team Member 4		
Team Member 5		
Team Member 6		
Team Member 7		
Team Member 8		

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

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

Joseph Sloop, Dean of School of Science and Technology, Georgia Gwinnett College

Project Information and Impact Data

Priority Category / Categories	Upper-Level Campus Collaborations
Requested Amount of Funding	$10,800
Course Names and Course Numbers	ITEC 3870 Software Development 2
Final Semester of Project	Fall 2020
Average Number of Students Per Course Section Affected by Project	16
Average Number of Sections Affected by Project in One Academic Year	4
Total Number of Students Affected by Project in One Academic Year	62
Average Number of Students Affected per Summer Semester	0
Average Number of Students Affected per Fall Semester	38
Average Number of Students Affected per Spring Semester	24
Original Required Commercial Materials	1) Roger S Pressman, Bruce Maxim. "Software Engineering: A Practitioner's Approach", 8th Edition (recommended textbook). $174 from campus bookstore: https://ggc.bncollege.com/shop/ggc/textbook/software-engineeringpracappr?sectionId=91175999&displayStoreId=54053&sectionList=&booksAddedforSec=&fromTBList=true 2) Steve McConnell "Code Complete: A Practical Handbook of Software Construction", 2nd Edition (recommended textbook). $55 from campus bookstore: https://ggc.bncollege.com/shop/ggc/textbook/code-complete-600000327413?sectionId=91175999&displayStoreId=54053&sectionList=&booksAddedforSec=&fromTBList=true 3) Robert C. Martin "Clean Code: A Handbook of Agile Software Craftsmanship" 1st Edition (recommended textbook). $50 from campus bookstore: https://ggc.bncollege.com/shop/ggc/textbook/clean-code-600000505529?sectionId=91175999&displayStoreId=54053&sectionList=&booksAddedforSec=&fromTBList=true

	4) Simon Holmes "Getting MEAN with Mongo, Express, Angular, and Node" 1st Edition (recommended textbook). $45 from campus bookstore: https://ggc.bncollege.com/shop/ggc/textbook/getting-mean-with-mongoexpress-600007977097?sectionId=91175999&displayStoreId=54053&sectionList=&booksAddedforSec=&fromTBList=true If you are redirected to the GGC bookstore, please choose Fall 2019, ITEC 3870 Section 01.
Total Price of Original Required Materials Per Student	$324
Post-Project Cost Per Student	$0
Post-Project Savings Per Student	$324
Projected Total Annual Student Savings Per Academic Year	$20,088
Using OpenStax Textbook?	No

NARRATIVE SECTION

1. PROJECT GOALS

In an article by Gutenberg Technology [1], it was stated that, "A growing number of college students are saving money by not buying the textbooks required for their courses. Some buy secondhand books instead…**while other students simply find similar content online and make use of that instead.**" Such was the case in the ITEC 3870 course taught by the project team.

ITEC 3870 is currently taught by only two professors (the writers of this proposal), Drs. Cengiz Gunay and Anca Doloc-Mihu. At this time, the course has no <u>required</u> textbook because of multiple reasons. First, in the Information Technology (IT) field, the knowledge is changing so fast that any book becomes old very quickly whereas up-to-date materials simply exist online. Therefore, students are reluctant to or do not buy textbooks; instead, they prefer to follow the presentation slides we used in the classroom and to search the internet for additional resources. But academic success suffers when students do not purchase a textbook, especially among students with a greater need for extra materials to improve their course understanding. The second reason for removing the textbooks is because the teaching faculty and the students have found the formerly required textbook to be outdated, repetitive, based only on reading and lecture style, and did not include any practical materials that students could learn via examples and could practice the new concepts. Since almost none of our students were purchasing the main textbook, we (out of desperation) recently changed our syllabus to list several <u>recommended</u> textbooks instead because no single source was sufficient.

To provide students with good software skills, we relied on various materials gathered from these four different books and online websites. However, this move confused the students and

their success suffered. Hence, we believe that it is urgent to provide students with a well-organized, free online textbook that includes all the necessary high-level software skills in one place, presented uniformly, along with examples, and that offers the possibility for the students to practice their skills right away via a real-world project-based learning approach. ALG is giving us the opportunity to put materials together from multiple resources and create such a novel resource. Thus, the purpose of this project is to provide students taking the ITEC 3870 Software Development II course with an online textbook that includes all the necessary updated and practical materials for the class that is at no cost to them.

The specific goals of the project are:

A. **Improve student success in the upper level Software Development track courses by creating on-line, customized, and organized course materials focused on up-to-date software development industry practices.**

The Georgia Gwinnett College (GGC) degree program in Information Technology (IT) has a Software Development (SD) concentration, which offers a final sequence of three courses for its junior and senior undergraduate students:

1) ITEC 3860 Software Development I (SD I) – 75 students average per year
2) ITEC 3870 Software Development II (SD II) – 62 students average per year
3) ITEC 4860 Software Development Project (SDP - final capstone course) – 55 students average per year

In this ALG application, we could have targeted the first course in this sequence, but we decided on creating a book for SD II because there is an urgent need for it. The first course, SD I, already has a fixed syllabus that takes the students through introductory material. But the second course, SD II, being the last course before the capstone project course, needs to fill in large gaps to prepare students for the workforce. It is not appropriate to simply follow a single textbook in this course, but instead cover a diverse set of materials from multiple resources to bring students to industry standards. The new materials for SD II will overlap with some of the modules in SD I and SDP and be beneficial for those courses, creating a synergy. Already some modules that we had developed in SD II (e.g., Github exercises and lectures) are being employed in the SD I course by two instructors and in the SDP course by one instructor. Therefore, this ALG application will create required materials for SD II and ancillary materials for SD I and SDP. We plan to properly revise and refine the materials for SD I and SDP courses in subsequent Mini Grant applications to ALG by reaching out to the instructors who regularly teach these courses.

The SD II course uses materials from several textbooks:
1) Roger S Pressman, Bruce Maxim. "Software Engineering: A Practitioner's Approach" 8th Edition in 2014, originally required textbook [2] - has 39 chapters and it is now recommended for SD II.
2) Steve McConnell "Code Complete: A Practical Handbook of Software Construction" 2nd Edition in 2004 [3] - has 35 chapters within 7 parts and recommended for SD II.
3) Robert C. Martin "Clean Code: A Handbook of Agile Software Craftsmanship" 1st Edition, 2008 [28] – has 17 chapters and recommended for SD II.
4) Simon Holmes "Getting MEAN with Mongo, Express, Angular, and Node" 2nd Edition, April 2019 [29] – has 12 chapters and recommended for SD II.

There are several problems regarding the use of these books.

1) Only parts of the books are ever used in class

   The course covers at most one third of its textbook's contents in one semester. Many of the chapters are never touched. For instance, the textbook by Pressman & Maxim [2] goes into very deep historical detail of legacy systems, which is not beneficial to our undergraduate students. Moreover, the Software Development field requires knowledge from many textbooks, such as the four suggested readings listed above. As these books are hard copies from different vendors, there is no way to customize their chapters into single books fitted for each of our course needs.

2) Textbooks' contents are not up to date, therefore missing important new concepts, technologies, and emerging paradigms

   The main textbook [2] is 5 years old and the oldest one is 15 years old. Moreover, none of the books can keep up with the constantly changing technologies required for software development. Lastly, only one book [29] covers important concepts and tools that are in our course syllabus and are highly used in IT industry. But others are still missing, such as Github and Jira for which we still must provide customized lessons and exercises.

3) Textbooks are not aimed at practice

   When technology is changing at the pace it is today with the amount of online material far surpassing any printed textbook, one must consider if the textbook knowledge is sufficient to prepare students for their careers. In addition to memorizing concepts, students also need to practice software development via practice projects. None of these books provides class design for project-based learning [12].

Our proposed solution to these issues is to provide a flexible free online repository of materials that can be customized and updated every semester. Moreover, collaborators from other college campuses can make their own versions based on our materials. The learning materials we plan to create will cover all the knowledge and skills students need to develop professional software applications using different tools, and will provide guidelines for instructors as well. Therefore, there will be no need for students to purchase textbooks and other materials. The customized free online textbook and materials will be created specifically to help SD students at junior/senior level improve their academic success.

B. **Improve student outcomes oriented towards the Software Development job market by designing course materials customized around a real-world client-based project to provide students with practice.**

The content in the current textbooks is focused on generic advice on how to develop different types of software with different methodologies without a systematic and quantifiable project development exercise. Instead, our course materials are focused on a real-world project developed using an Agile methodology. We will provide setup guides for instructors to conduct their own course projects. By using the project-based online course materials, students will have the opportunity to design and implement a real software application mimicking the entire Software Development (SD) process that one encounters in a professional environment. The process must also be quantifiable and measurable to enable engineering improvements of the

process. Using a process tracking software during the course allows students to practice and learn industry tools designed for this purpose. According to the latest State of the Agile Report [7], the most commonly used tool for tracking Agile-style software development is Jira [6]. Therefore, we include practical lessons on Jira in our course. We believe this pedagogical transformation will fill the gap of textbook knowledge and real-world application and in return improve the student success rate on getting a SD job.

C. **Eliminate student expenses in textbook purchases.**

The price of the textbooks is also an obstacle to student learning. The recommended textbooks for our SD II course are expensive, having a price of $111 at our college bookstore in the cheapest condition (renting a digital or used copies). Buying new copies of all would cost $324. The recommended readings are useful because they provide the additional skills and knowledge more than any one textbook can provide. Students usually wait to buy or do not purchase the textbooks and try to rely on course notes, which do not provide enough explanation. A significant portion of our students struggle with these courses and have low class performance. In fall 2018, roughly 25% of our 33 SD II students received DFW grades. Part of the cause may be their inability to obtain the classroom resources they need to gain the knowledge, skills, and training they need to be academically successful — something that we, as instructors, can assist them with through the ALG Textbook Transformation grant, and we will assess whether any improvements will be achieved.

The three SD sequence courses ITEC 3860 SD I, 3870 SD II, and 4860 SDP are mandatory in our SD concentration, which is the largest of the five IT concentrations at GGC. A total of 192 students annually takes all three SD courses, and this number is expected to grow at a steady rate. SD II has 62 students annually. SD has consistently been the largest concentration between 2013 and 2017, with a growth of 75% as compared to the overall growth of 70% over all IT concentrations [22], which is higher than the national average because of GGC's fast initial growth as a young institution. However, the importance of the IT field is expanding nationally. The Bureau of Labor Statistics (BLS) estimates a 24% growth in the SD workforce between 2016 - 2026, faster than the average for all occupations [19]. Even though the total number of students we teach in this course is on average modest, there is an upward trend based on incoming software development concentration students. The enrollment in first sequence course, Software Development I, has increased by 10 students between 2018 and 2019. Therefore, we anticipate adding more sections of next sequence SD II course in the future.

D. **Share the learning materials with other USG campuses to benefit more students.**

As an Upper-Level Campus Collaborations proposal, we aim to provide materials that could be adopted by other institutions. Software development is a popular field and schools in the area have different courses for teaching it. We have identified the following courses that offer a similar content and that can benefit from our proposed materials:

1) University of Georgia (UGA) CSCI 4050/6050 Software Engineering
   http://www.cs.uga.edu/courses/content/csci-40506050
2) Georgia Institute of Technology (GA Tech) CS 6300: Software Development Process (Software Engineering: Concepts and Practice) http://www.omscs.gatech.edu/cs-6300-software-development-process

3) Georgia State University (GSU) CSC 4350 Software Engineering
   https://catalog.gsu.edu/undergraduate20182019/computer-science/
4) Kennesaw State University (KSU) has a Bachelor of Science major in Software
   Engineering (https://ccse.kennesaw.edu/undergraduate/choosing-a-major.php), which
   includes the following relevant courses:
   - SWE 3313 Introduction to Software Engineering
   - SWE 3623 Software Systems Requirements
   - SWE 3633 Software Architecture & Design
   - SWE 4663 Software Project Management
   - SWE 4713 SWE Application Domain
   - SWE 4724 Software Engineering Project

In the first phase of this project, we plan to focus on only the courses offered at GGC and produce online materials that can be further extended. Once the first phase is completed, we plan to notify instructors of the above courses, seeking for collaboration opportunities.

As opposed to providing materials inside an institution-locked learning management system (LMS), such as the Desire2Learn (D2L) Brightspace used at GGC, we will make the created learning materials available on outside public websites and repositories that are freely accessible to all the USG faculty and further (such as Github [15]). This open-source textbook model encourages sharing and further improvement by others, and it is true to the mission of ALG. The materials provided can be used as a replacement to their current textbooks or supplement teaching materials. This will increase the student impact of this proposal to a much larger scale than that offered at GGC.

2. STATEMENT OF TRANSFORMATION

Overview of the Transformation

In an August 7, 2018, Medium.com article [17], Jessica Williams stated that software development ranks as the number 1 job in the U.S. In fact, CIO, a leading digital magazine for IT executives and decision-makers, listed developers (web, software, and mobile) as one of the top 13 in-demand tech jobs for 2019 [18]. The Bureau of Labor Statistics also projected employment for software developers to grow 24% into 2026 [19]. But this growth may not be enough to satisfy the need. In an open letter by the Computer Science Education Coalition [20], signed by American leaders in business, education, and government, including twenty-eight governors, estimate that there are currently 500,000 open computing jobs in every sector to be filled, but there are only 50,000 computer science/information technology graduates per year. In the state of Georgia, according to the Georgia Department of Labor, Computer & Math related job openings are estimated to grow by 16,030 by 2026 according to the Workforce Trends publication [21]. This remarkable employment trend is significant for GGC's IT students, especially that in the School of Science and Technology. **IT students represent the second largest group of first-generation students, the largest group who receive financial aid, and the largest group from ethnic groups who are traditionally under-represented in high-paying STEM fields. Through this project, GGC will have the ability to ease the students' financial burden and to provide them with appropriate, quality tools to pass their classes and enter the job market sooner.**

Information Technology is the most popular major in GGC, with over 10% of students majoring in the field [22]. The major has been successful in the national scene when student competitors received Top School award in 2018 by the USITCC organization [23]. The most popular concentration with 42% of IT major students is Software Development (SD). <u>The course that we target in this proposal is required for students in the SD concentration. The course recommends textbooks that are in the high end of technology books.</u> The total price of the textbooks is $324 as explained in the Project Goals section above [4, 5, 24]. Textbooks are frequently updated, which negatively impacts their resale value. In addition, students must have a powerful laptop computer to take this course, which adds an additional $350 or more financial burden. Therefore, having no-cost books in this course will significantly decrease the financial burden on IT students. This is important because then the students will need to spend less hours working jobs outside of school.

As knowledge in the SD field is very diverse and changing constantly, up-to-date instruction requires integrating information from multiple sources. Despite frequent updates, most of the available textbooks are outdated very quickly and fail to include all aspects that an instructor would like to convey in one course. For instance, the SD I course relies on object-oriented software development textbook [24] that focuses solely on Java, which is ranked down at 9th place today among most wanted computing languages and it has been losing popularity [25]. In the SD II course, we must expose students to more languages. There are several upcoming languages and frameworks that the students do not get exposed by using such obsolete textbooks. It is true that many colleges still focus on a Java-only curriculum, but a less-known institution like GGC requires its students to distinguish themselves from graduates of other more-known schools. Exposing students to a variety of computing languages and frameworks would potentially increase their employment chances. Another emerging topic that is missing from the classical textbooks on the topic is the wide scale adoption of Agile Methodologies in the industry. Most of the books focus on older Waterfall Methodologies. There are new books that solely focus on Agile, but that would be yet another textbook to purchase for students. We aim to include a comparison of both methodologies and their pros and cons. Most learning resources for these additional SD topics are abundant online today [8-11], which confuses students as they need a clear structured guidance to navigate them. Many of these resources are publicly accessible, free, or with an open license to use. With our approach to creating materials, we can link to these outside resources easily.

<u>The investigators of this proposal aim at creating new, no-cost materials to replace the costly textbooks, but more importantly, achieving more and better learning outcomes by providing more up-to-date and career-relevant topics in SD courses.</u> Currently, students of the SD courses access presentation materials and resources through the D2L LMS managed by GGC and through the several required and recommended textbooks mentioned above. Our vision of this transformation is to create new materials that will be completely freely accessible, such that they do not depend on GGC's D2L system and are accessible even outside of GGC. This would increase the impact of the proposed materials to reach many more students within University System of Georgia and beyond.

In this proposal, we will start by creating textbook materials for the ITEC 3870 SD II course, which will also be useful for some modules in SD I and SDP courses because of their overlap. By not tying the SD II course to a single specific textbook and reading materials, we also plan on

transforming the contents of the course. <u>Instead of a linear lecture course, we propose to create **project-based** teaching and learning course materials, with required theory and concepts provided as needed.</u> The knowledge covered will be focused on building a fully-fledged software development project by the students. This project would entail going through the phases of software development process, requirements gathering, architectural design, implementation, and testing to produce a real-world software product. Project-based learning (PBL) has been known to increase student engagement and performance. PBL is a student-centered pedagogy that involves a dynamic classroom approach, which aims for students to acquire a deeper knowledge through active exploration of real-world challenges and problems [12]. It can be considered an active learning and inquiry-based learning categories. A meta-analysis conducted by Purdue University found that when implemented well, PBL can increase long-term retention of material and replicable skill, as well as improve teachers' and students' attitudes towards learning [13]. For the software development and engineering fields, it has been shown that real-world projects and case studies increase effectiveness of education [14]. Practical knowledge becomes crucial in preparing students for real-world career path, which has very steep experience requirements for current tools and computer languages. By using the proposed project-based course materials, we believe students will improve class engagement and learning satisfaction, gain experience in working on real-world applications, and improve student success rate in getting a job in the SD field.

Project's transformative impact on course and department

The stakeholders directly affected by the transformation will be approximately 192 traditional and non-traditional undergraduate students annually who are enrolled in the sequence of Software Development courses at GGC. These students are from diverse backgrounds and include underrepresented and underprivileged populations. As such, GGC has been selected as the "#1 most ethnically diverse southern regional college" by the US News & World Report magazine in the last five consecutive years [26, 27].

In the first phase of this project, we are proposing to target materials for the SD II course, which overlap with other two courses. The prerequisite course, ITEC 3860 Software Development I, and the final capstone project course, ITEC 4860 Software Development Project, go over some of the technologies and methodologies of SD II to practice and repeat. Therefore, their students will benefit also from this textbook transformation. It is worth mentioning that the two professors (the writers of this proposal), Drs. Cengiz Gunay and Anca Doloc-Mihu are the sole teachers of this course, SD II, and they are also part of the Software Development Goal Team Committee in the department, therefore they are fully knowledgeable of the SD concentration and departmental needs and requirements. Moreover, Dr. Doloc-Mihu is also teaching the SD I course once a year, and Dr. C Gunay is teaching the SDP course.

The transformation process will simplify the SD course materials and help remove and eliminate the cost of expensive textbooks for students. All materials will be accessible online at no cost and will be organized such that they can easily be updated as the content changes to incorporate the latest SD technology. Students will have access to up-to-date course learning materials on the first day of class.

The project-based learning approach that we plan to take will better engage our students, as they know that every skill they learn in the course will be used to build real-world software. This will

help to improve engagement, attendance, and retention. The experience gained from working on a real-world software application will benefit their future career success, which is especially important in a software development career.

Project's transformative impact on institution

The course we selected is required for the Information Technology major students in the Software Development concentration and is an elective for the other IT concentrations at GGC. In completing this project by creating materials for the SD II course, we provide a successful transformational example to the two other similar courses in the SD concentration at GGC: the prerequisite course, ITEC 3860 Software Development I, and the final capstone project course, ITEC 4860 Software Development Project. Both courses can benefit students through a textbook transformation to improve pedagogy and reduce costs. Therefore, the current proposal's success would enable their student's future transformation.

We aspire that the successful transformation through this project with zero textbook cost, better course engagement, and student satisfaction will attract more students to the SD major. The proposed project-based approach strongly supports the mission of GGC "... innovative use of technology and active-learning environments to provide students enhanced learning experiences, practical opportunities to apply knowledge..." We aspire that our course transformation will inspire other areas and disciplines at GGC and the USG at large to adopt/adapt free online textbooks.

3. TRANSFORMATION ACTION PLAN

Organization of Current Textbooks versus Proposed Transformed Textbook

Current Textbooks	Proposed Transformed Textbook

Roger S Pressman, Bruce Maxim. "Software Engineering: A Practitioner's Approach", 8th Edition.
 	
1. The nature of software
2. Software engineering
3. Software process structure
4. Process models
5. Agile development
6. Human aspects of software engineering
7. Principles that guide practice
8. Understanding requirements
9. Requirements modeling: scenario-based methods
10. Requirements modeling: class-based methods
11. Requirements modeling: behavior, patterns, and web/mobile apps
12. Design concepts
	Our proposed book is organized as follows:
	
	1. Software engineering process
	    a. Process models
	    b. Software architectures
	    c. Web-app technologies
	2. Agile Development
	    a. Principles
	    b. Scrums
	    c. Kanban
	3. Requirements in Agile
	    a. Client meeting
	    b. Requirements
	    c. Teamwork
	    d. Communication
	4. Version Control
	    a. Github
	    b. Markdown language
	5. Project Management with Jira

13. Architectural design
14. Component-level design
15. User interface design
16. Pattern-based design
17. Web-app design
18 Mobile-app design
19. Quality concepts
20. Review techniques
21. Software quality assurance
22. Software testing strategies
23. Testing conventional applications
24. Testing object-oriented applications
25. Testing web applications
26. Testing mobile applications
27. Security engineering
28. Formal modeling and verification
29. Software configuration management
30. Product metrics.

Steve McConnell "Code Complete" 2nd ed, 2004
  I. Laying the foundation
  II. Creating high-quality code
  III. Variables
  IV. Statements
  V. Code improvements
  VI. System considerations
  VII. Software craftsmanship

Robert C. Martin "Clean Code: A Handbook of Agile Software Craftsmanship" 1st Edition, 2008

  1. Clean code
  2. Meaningful names
  3. Functions
  4. Comments
  5. Formatting
  6. Objects and data structures
  7. Error handling
  8. Boundaries
  9. Unit tests

Simon Holmes "Getting MEAN with Mongo, Express, Angular, and Node" 2nd Edition, April 2019

6. Creating high-quality code
   a. Interview questions
   b. Common techniques
   c. Performance
7. Web-apps
   a. Architectural design
   b. TypeScript
   c. JavaScript
   d. CSS and HTML
   e. Angular or React
8. NoSQL databases
   a. JSON
   b. MongoDB
   c. Firebase
   d. Couch and pouch
9. Full stack architecture
   a. Angular
   b. MEAN
   c. MERN
   d. Ionic framework
10. Advanced Web-app concepts
   a. Bootstrap
   b. Heroku
   c. Amazon Web Services
11. Project design and management
   a. Phase 1: Start, gathering requirements, team, mockup
   b. Phase 2: Analysis, design, implementation, testing
   c. Phase 3: Bug fixes, testing, deliverables
12. Legal issues in software development
   a. Intellectual property
   b. Licensing

1. Setting the baseline	
2. Building a Node web application	
3. Adding a dynamic front-end with Angular	
4. Managing authentication and user sessions	

A. The identification, review, selection, and adoption/adaptation/creation of the new course materials

In this phase, the new course materials will be identified and created based on course objectives (with planned adjustments, see below) and student learning outcomes of the ITEC 3870 Software Development II course. The course materials will be focused on the process of building a real-world software development application, and most of them will be produced by using publicly available resources.

The primary resources we plan to include in the new materials are shown above. For each of the chapters, we will provide the following: lessons, example practice, hands-on assignments, all customized to include a beginner, intermediate, and advanced version.

We plan to provide faculty teaching a SD II course with a guideline on how to create an Agile-style project-based classroom environment, including:

- selecting external clients,
- teaching students soft skills and technology skills,
- involving how to work in teams during the software development process,
- leading communication between clients and student teams, and
- presenting project demonstrations and testing sessions at local symposia (e.g. CREATE Symposium and STaRS events at GGC).

B. Preliminary plan to create new materials

The topic list above will be complemented with new materials. **Note that even though the scope of this project may look too big for a team of two faculty, some of these materials already exist (but not in a uniform, easily accessible format) and are used in the current classes.** Our plan is to make them more uniform, general, and accessible. We are also planning to keep the chapter readings as concise as possible as this would make them easy to maintain, and easier for students to read as they are having shorter attention spans to read long materials. Here are some types of materials we will include:

- Custom lessons: supporting theory and concepts provided as needed,

- Custom practical mini hands-on exercises to get students warmed-up to the new technology,

- Custom assignments for some commonly used technologies,

- Custom Agile-style software development environment to be taught and created for students to practice their project-based skills in teams during class and at home via communication tools like Slack and Discord,

- Guidelines and examples on Client-Team communication,

- A gradebook sample that incorporates all the assignments and tests for each iteration of the Agile-style process,

- Guidelines and grading criteria on how to grade the team-based project at each iteration of the Agile process.

- Guidelines on how to pace the semester and schedule different course assignments and development milestones for Agile iterations.

A sample course syllabus will be provided that reflects the transformation. For example, it will include course material information, grade distribution, a tentative course schedule, etc. The syllabus will be modified to reflect the no textbook format. During the semester, a copy of the syllabus will be made available on D2L. A link to the website holding all new course materials will be provided on D2L.

The hands-on assignments and the team project will be graded components, with the project having the biggest weight. Each Agile iteration of the project will have a component in the gradebook. The contents covered in the course will be mapped to the modified course objectives.

We aim for this pedagogical transformation to fill the gap between textbook knowledge and real-world application and in return improve student success rates on getting a SD job.

C. Curriculum redesign needed for material transformation

We will be adjusting the course outcomes to reflect the newly transformed course contents and the up-to-date, according-to-industry-standards materials. We will add assessment outcomes for source code tracking using version control systems, project management and development topics, and Agile software development.

Team members' roles

Each team member will have full control over their own modules, but will collaborate to create coherent course contents.

Team member: Cengiz Gunay, Assistant Professor of Information Technology, as a subject matter expert and instructional designer, will:

- Identify and create new course material modules independently.
- Oversee the entire transformation process.
- Select and develop study material for all iterations of the project.
- Develop hands on activities.
- Complete and analyze all grade/survey related data for the course.
- Submit an IRB application to collect the survey and archival grade data.

- Develop guidelines on how to establish connections with external clients.
- Lead the process of development of custom course materials.

Team member: Anca Doloc-Mihu, Assistant Professor of Information Technology, as a subject matter expert and instructional designer, will:

- Create new course material modules independently including developing lecture notes/course PPT slides.
- Identify online free complementary reading materials/tutorials/video clips for each course topic.
- Select and develop study material for all iterations of the project.
- Develop hands on activities.
- Set up and maintain the website course material.
- Set up and maintain the proposed gradebook template (compatible with D2L) for this project.

Here is a breakdown of PI assignment for the major topics covered in the transformation:

- Introduction to Agile-style project – organizing content, lecture notes, practical guidelines, active learning assignments, practical concerns, project application [Dr. Doloc-Mihu]
- Introduction to complex software development projects – organizing content, lecture notes, practical guidelines, active learning assignments, practical concerns, project application, client-team introductions, project selection guidelines [Dr. Gunay]
- Main materials per technology – organizing content, lecture notes, practical guidelines, active learning assignments, practical application to project:
  - o Github, Markdown language, JIRA [Dr. Gunay]
  - o Angular 6, JSON, MEAN [Dr. Doloc-Mihu]

Plan for providing access

The new course materials will be hosted online, on a freely available portal, such that students and faculty from the entire USG system will have free access to materials any time. We will put links to all our materials on GGC's D2L, but we will not lock it into D2L because we want to make it truly available to everyone, and not just to GGC community. A problem with GGC's D2L is that **even faculty at GGC may not know that course materials exist** because we cannot see other faculty's D2L unless specifically given permission. In addition, old courses can be easily forgotten. Instead, we will provide fully open, online materials that can be accessed by anyone freely without locking under a specific school's portal (e.g., on Github.com). All students who take this course will have free access to the materials on the first day of class and throughout life.

This website will be used to post all the course materials, announcements, assignments, and instruct students were to submit their homework. No grades or student information will be posted

on the website. Students will take tests and quizzes on GGC's D2L, where they will have their grades posted privately.

We will use various online software development services for students to post their products for homework and projects (since D2L does not provide this function). Note that students can register for free accounts on these web sites (e.g., JIRA, GitHub, BitBucket, etc.).

4. QUANTITATIVE AND QUALITATIVE MEASURES

Questionnaires will be administered using a surveying tool approved by the IRB committee at GGC. Data analysis will be done via Excel sheets.

The PIs will collect the data below for each goal. Quantitative data will be collected from faculty who are conducting courses using the newly proposed materials. For example, they will be asked to evaluate statements on a 1-5 Likert-scale from strongly disagree to strongly agree. See below for specific data items for each goal.

Qualitative data will be collected by surveying faculty, students, and project clients. There will be open-ended questions to get feedback. The data will be collected at the end of the semester and compared with similar data from prior semesters when this material was not available. The comparison result will be used to evaluate the efficacy of the course materials in improving student success.

GOAL A: Improve student success in ITEC 3870 (Software Development II) by creating on-line, customized, and organized course materials focused on software development industry practices.

Qualitative Measure, Methods, and Tools

Open-ended questions will be asked:

- How can we improve the new course material?
- What would be one thing that can be added to the course material?
- Other comments or suggestions about this course?
- How did the availability of no-cost online textbook and materials help improve your learning?

Quantitative Measure, Methods, and Tools

We will administer a student survey that will assess students' responses (Strongly disagree/Agree) on the following statements.

- The materials clearly explained concepts. The materials are useful to learn the concepts.
- The materials include enough exercises and examples to help me learn the concepts.

We will collect data on course success as required by ALG instructions and compare it to previous data from the course to check for improvements in the following:

- Retention rate in the course
- Passing and failing rate
- Drop and withdraw rate
- Percentage of students getting As, Bs, Cs, Ds, Fs, and
- Percentage of students achieving student learning outcomes.

GOAL B: Improve student outcomes oriented towards the Software Development job market by designing course materials customized around a real-world client-based project to provide students with practice.

<u>**Qualitative Measure, Methods, and Tools**</u>

Open-ended questions will be asked to the students:

- How can we improve our project-based learning approach?

We will follow up with students to learn about their job application experiences and quality of the job they found (if available) in the SD industry.

We will also ask external clients who are involved with student project the following survey:

- Comments on satisfactory student progress towards the software product

<u>**Quantitative Measure, Methods, and Tools**</u>

We will administer a student survey that will assess students' response (Strongly disagree/Agree) on the following statements:

- Project-based course materials are very important to learn and practice SD skills.
- I learned all the knowledge and skills needed to build a software project.
- The team-based project learning experience was useful. The team-based project helped me build my communication skills, and my teamwork skills.

We will collect data on:

- Source code progress metrics on JIRA, Github, etc.
- Quantitative metrics listed in Goal 1 would also apply here.
- Follow up with students to measure the time (in months) it took to get a job in the SD industry.

GOAL C: Eliminate student expenses in textbook purchases.

<u>Qualitative Measure, Methods, and Tools</u>

Open-ended questions will be asked:

- How much did you spend on course materials?
- Did the availability of No-Cost-to-Students Learning Materials help improve your success in the course?
- What were the challenges of using the No-Cost-to-Students Learning Materials?

<u>Quantitative Measure, Methods, and Tools</u>

We will administer a student survey that will assess students response (Strongly disagree/Agree) on the following statements.

- The materials are well organized so that necessary information can be found easily.
- The availability of No-Cost-to-Students Learning Materials helped improve my success in the course.

We will collect institutional data to compare with baseline on:

- Course enrollment numbers. Data will be used to determine overall student savings.

GOAL D: Share the learning materials with other USG universities and colleges to benefit more students.

In the first phase on this project, we aim to create the materials for GGC students and post them online for anyone to view. We plan to present our newly developed course materials at conferences. We will share our materials with interested faculty and track their usage and success via a short survey at the end of each semester.

<u>Qualitative Measure, Methods, and Tools</u>

- Survey conference participants for adoption interest and general feedback of usefulness
- Survey faculty who adopted the materials on general feedback on usefulness of materials

<u>Quantitative Measure, Methods, and Tools</u>

- Tracking of number of downloads
- Tracking of locations from where requests originated
- Collaborate with volunteer instructors to track their student numbers

5. TIMELINE

Program start: Fall 2019-Fall 2020

Note that the pace of the timeline below may look slow. However, preparation for upper-level courses is more work-intensive and demanding because of its industry/career-focused materials, resources, and activities.

Fall 2019 (Starting in November 2019 after the kickoff)

- Research and identify a publicly and freely accessible website to hold all materials.
- Refine materials to be added into the website
- Prepare and submit IRB proposal for assessment by developing survey questionnaires

Spring 2020

- Start drafting modules for the project-based course materials. These include all reading materials, lecture notes, video clips, exercises, labs, and assignments.
- Start drafting course level materials redesign. This includes quizzes, tests, and syllabus.

Summer 2020

(No teaching assignments – focus on ALG)

ITEC 3870 (Software Development II) is not taught during the summer term at GGC.

- Revise drafts of course materials created and finalize them.
- Revise surveys.
- Identify and prepare for conference submission.

Fall 2020

- Administer the transformed textbook in both sections of ITEC 3870 SD II.
- Student surveys on the transformed textbook as proposed above.
- Analyze data collected. Finish quantitative and qualitative data analysis.
- Compile final report.
- Submit findings at conferences and recruit faculty members to adopt the materials.

6. BUDGET

A. Type of Grant: Standard Transformation grant

B. Budget request: $10,800

C. Budget justification

(1) Personnel: $10,000

Dr. Cengiz Gunay: $5,000

Dr. Gunay will select and develop study material for all iterations of the project, develop hands on activities, complete and analyze all grade/survey related data for the course. He will submit an IRB application to collect the survey and archival grade data. He will also develop guidelines on how to establish connections with external clients and will lead the process of development of custom course materials. The requested pay will cover base pay and fringe benefit.

Dr. Anca Doloc-Mihu: $5,000

Dr. Anca Doloc-Mihu will create new course materials, which include developing lecture PPT slides, along with identifying online free complementary reading materials/tutorials/video clips for each course topic. In addition, she will set up and maintain the website course material and the proposed gradebook template (compatible with D2L) for this project. She will build up practice exercises, assignments, and quizzes for all topics of the course. The requested pay will cover base pay and fringe benefits.

(2) Travel: $800

Travel expense: $800 for both PIs to attend the kick off meeting at $400 each. Travel will cover mileage, lodging, and other travel expenses.

Only open source software and web hosting will be used in this project, thus there is no additional spending on software or equipment purchasing.

Total Request: $10,800

7. SUSTAINABILITY PLAN

The selected SD II course is a required course for the IT major with Software Development concentration at GGC. We target the ITEC 3870 SD II course, which will also indirectly impact students in the SD I and SDP courses because of the overlapping topics. For instance, the Github exercises originally developed for the SD II course is now regularly employed in the SD I course at GGC by various instructors. We plan to properly revise the materials for SD I and SDP courses in subsequent Mini Grant applications to ALG by reaching out to the instructors who regularly teach these courses.

There are two sections of SD II taught each academic semester. We plan to employ the no-cost-to-students materials in both sections for two semesters, so that data from enough number of students are collected. These results will be analyzed as described above and disseminated in local symposia and conference presentations. PIs expect that this project will impact student achievement not only by eliminating textbook and software costs, but most importantly by increasing student engagement in the material inside and outside of the classroom, improving academic performance, which in turn improve retention in this course and student prospects after graduation.

Considering these benefits, the PIs will propose to standardize these resources for future offerings of ITEC 3870, which will also provide ancillary resources for the SD I and SDP courses. Since Dr. Gunay serves as the SD II course coordinator in the School of Science and Technology and both PIs are in SST's Software Development Goal Team, they will be able to promote the adoption of these materials for long-term use. A course coordinator at GGC is the faculty who oversees determining syllabus and textbook assignments for a specific course.

It will also be simple to keep using and maintaining the materials once they are published since they require no paid software. Course materials will be updated periodically by faculty in the Information Technology program to reflect feedback from students and instructors and newly emerging topics in SD in the industry. If there is a need to make significant improvements to the materials or add ancillary materials, we will apply for another ALG grant in the future.

The website will be hosted on a public platform that allows "forking", which means other instructors can make their own customized versions of the materials. This way, many versions of the materials can exist and could help sustainability of the effort.

We plan to prepare scholarly products such as poster presentations and articles in conference proceedings evaluating results of our planned study. We will target a computer science conference with educational research topic, such as the Association for Computing Machinery's (ACM) Special Interest Group on Computer Science Education, or ACM's Richard Tapia Celebration of Diversity in Computing conference.

REFERENCES

1. Gutenberg Blog. Gutenberg Technology. "Why Students Avoid Buying Textbooks." June 28, 2018. Retrieved from https://blog.gutenberg-technology.com/en/students-avoid-buying-textbooks
2. Roger S Pressman, Bruce Maxim. "Software Engineering: A Practitioner's Approach" 8th Edition, ISBN: 978-0078022128, McGraw-Hill Education, 2014.
3. Steve McConnell "Code Complete: A Practical Handbook of Software Construction" 2nd Edition, ISBN: 978-0735619678, Microsoft Press, 2004.
4. Robert C Martin. "Clean Code: A Handbook of Agile Software Craftsmanship" 1st Edition, ISBN: 978-0132350884, Prentice Hall, 2008.
5. Eric Freeman, Bert Bates, Kathy Sierra, Elisabeth Robson. "Head First Design Patterns: A Brain-Friendly Guide" 1st Edition, ISBN: 978-0596007126, O'Reilly Media, 2004.
6. Atlassian JIRA, https://www.atlassian.com/software/jira. Retrieved on 1/13/2019.
7. Collab.Net, VersionOne. "The 13th Annual State of the Agile Report". 2018.
8. Arylee McSweaney and Rebecca Sliter. "Syllabus: Agile Software Development" https://www.oercommons.org/courses/syllabus-agile-software-development OER Commons. Date Added: 11/23/2018. Retrieved on 1/13/2019.
9. Ellen Ambakisye Kalinga "Software engineering" https://www.oercommons.org/courses/software-engineering-3 OER Commons. Date Added: 2/10/2018. Retrieved on 1/13/2019.
10. Georgia Tech "Software Development Process." Free course. Udacity.
11. Hubert Baumeister, Horst Lichter, Matthias Riebisch. "Agile Processes in Software Engineering and Extreme Programming" SpringerLink. May, 2017.

12. ″Project-Based Learning″, Edutopia, March 14, 2016. https://www.edutopia.org/project-based-learning Retrieved 1/13/2019.
13. Strobel, J. Barneveld, A. "When is PBL More Effective? A Meta-synthesis of Meta-analyses Comparing PBL to Conventional Classrooms." Interdisciplinary Journal of Problem-Based Learning. Volume 3, Article 4. 2009.
14. Kirti Garg, Vasudeva Varma. "A Study of the Effectiveness of Case Study approach in Software Engineering Education" 20th Conference on Software Engineering Education & Training (CSEET'07), 2007.
15. Github, http://www.github.com . Retrieved 3/20/2019.
16. Simon Holmes "Getting MEAN with Mongo, Express, Angular, and Node" 1st Edition, Manning Publications, 2015.
17. Jessica Williams "Software Development Trends in 2018 that Will Dominate 2019". Retrieved from https://medium.com/@Jessicawlm/software-development-trends-in-2018-that-will-dominate-2019-db1a1681c84d on April 1st, 2019.
18. Sarah K. White. "The 13 most in-demand tech jobs for 2019 — and how to hire for them" Retrieved from https://www.cio.com/article/3235944/hiring-the-most-in-demand-tech-jobs-for-2018.html on April 1st, 2019.
19. US Department of Labor, Bureau of Labor Statistics, Occupational Outlook Handbook, Software Developers. Retrieved from https://www.bls.gov/ooh/computer-and-information-technology/software-developers.htm on April 1st, 2019.
20. Computer Science Education Coalition (2016). An Open Letter to Congress. https://code.org/files/open_letter_for_cs.pdf (visited, 2019/09/01).
21. Mark Butler, Commissioner, Georgia Department of Labor "Workforce Trends: An Analysis of Long-term Employment Projections to 2026". Undated. Retrieved from https://explorer.gdol.ga.gov/vosnet/mis/Current/gaworkforcecurrent.pdf on Sep 1, 2019.
22. Robert Lutz, IT faculty chair, GGC. "GGC IT Program Overview" 2019 (internal report)
23. Kevin Jetton, "USAA 1st Annual USITCC hihglights and Winner Circle", April 18, 2018. Retrieved from http://usitcc.com/wp-content/uploads/2018/04/2018-USITCC-HighlightsWinners.pdf on Sep 1, 2019.
24. Bruegge. "Object-oriented software engineering." 3rd edition. 2010. Pearson Publishing.
25. StackOverflow Developer Insights Survey Results 2019. https://insights.stackoverflow.com/survey/2019 . Retrieved on Sep 1, 2019.
26. Curt Yeomans "U.S. News and World Report names GGC as South's most diverse regional college" Sep 15, 2017 https://www.gwinnettdailypost.com/local/u-s-news-and-world-report-names-ggc-as-south/article_01460bba-e9b0-5b18-b70f-7cd326e015c9.html
27. No author "GGC maintains top 10 U.S. News & World Report ranking" https://www.ggc.edu/about-ggc/news/News/ggc-maintains-top-10-us-news--world-report-ranking Retrieved on Sep 2, 2019.
28. Robert C. Martin "Clean Code: A Handbook of Agile Software Craftsmanship" 1st Edition, Prentice Hall, 2008.
29. Simon Holmes "Getting MEAN with Mongo, Express, Angular, and Node" 2nd Edition, Manning Publications, April 2019.