Table of Contents

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:	Paola Spoletini
Appplication ID:	3633
Application Title:	501
Date Submitted:	09/17/2019 at 8:43 AM

Personal Details

Institution Name(s):	Kennesaw State University
Applicant First Name:	Paola
Applicant Last Name:	Spoletini
Applicant Email Address:	pspoleti@kennesaw.edu
Applicant Phone Number:	4705783811
Primary Appointment Title:	Professor of Software Engineering
Submitter First Name:	Paola
Submitter Last Name:	Spoletini
Submitter Email Address:	pspoleti@kennesaw.edu
Submitter Phone Number:	14705783811
Submitter Title:	Professor of Software Engineering

Application Details

Proposal Title

501

Requested Amount of Funding

10,800

Priority Category (if applicable)

Final Semester:

Fall 2020

Course Title(s)

Requirements Engineering, Software Testing and Verification, Formal Methods

Course Number(s)

SWE 6613, SWE 6673, SWE 6883

Team Member 1 Name

Paola Spoletini

Team Member 1 Email

pspoleti@kennesaw.edu

Team Member 2 Name

Reza Parizi

Team Member 2 Email

rparizi1@kennesaw.edu

Team Member 3 Name

Team Member 3 Email

Team Member 4 Name

Team Member 4 Email

Additional Team Members (Name and email address for each)

Sponsor Name

Dr. Svetlana Peltsverger

Sponsor Title

Associate Dean in the College of Computing and Software Engineering

Sponsor Department

College of Computing and Software Engineering

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

45, 45, 20

Average Number of Sections Affected by Project in One Academic Year

1, 1, 1

Total Number of Students Affected by Project in One Academic Year

90

Average Number of Students Affected per Summer Semester

0-20

Average Number of Students Affected per Fall Semester

65

Average Number of Students Affected per Spring Semester
45

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

[1]. Software Requirements, Third Edition
by Karl E. Wiegers, Microsoft Press, 2013
ISBN: 978-0-7356-7966-5
$ 49.99

https://www.microsoftpressstore.com/store/software-requirements-9780735679665

[2]. More About Software Requirements: Thorny Issues and Practical Advice by Karl E. Wiegers, Microsoft Press, 2005 ISBN: 978-0-7356-2267-8 $39.99

https://www.microsoftpressstore.com/store/more-about-software-requirements-thorny-issues-and-9780735622678

[3]. The Software Requirements Memory Jogger: A Pocket Guide to Help Software And Business. Teams Develop and Manage Requirements by Ellen Gottesdiener, GOAL/QPC, ISBN: 978-1-57681-060-6 $18.65

https://www.amazon.com/Software-Requirements-Memory-Jogger-Gottesdiener/dp/B01FJ1CY7Q

[4]. Software Testing and Analysis: Process, Principles and Techniques By Mauro Pezzè, Michal Young Wiley, 2008 ISBN : 978-0-471-45593-6 $ 69.09

https://www.amazon.com/Software-Testing-Analysis-Principles-Techniques/dp/0471455938

[5]. An Introduction to Discrete Mathematics, Formal System Specification, and Z, Second Edition, 1992, By D. C. Ince, Oxford University Press, 1992, ISBN: 0-19-853836-7 $124.95

https://global.oup.com/academic/product/an-introduction-to-discrete-mathematics-formal-system-specification-and-z-9780198538363?cc=us&lang=en&

[6]. The Object Constraint Language, Second Edition: Getting Your Models Ready for MDA, 2003, Jos Warmer and Anneke Kleppe, Addison-Wesley, Pearson Education ISBN: 978-0-321-17936-4 $44.99

https://www.amazon.com/Object-Constraint-Language-Getting-Models/dp/0321179366

Original Total Cost per Student
$347.66

Post-Project Cost per Student
$0

Post-Project Savings per Student
$347.66

Projected Total Annual Student Savings per Academic Year
$31,000

Using OpenStax Textbook?
No

Project Goals

The Master of Science in Software Engineering (MSSWE) at Kennesaw State University (KSU) is a very successful growing program with around 90 enrolled students in 2019. The MSSWE can be taken on campus, online, or combining the two modalities. The program welcomes not only regular students with an undergraduate in a computing discipline, but also career changers, i.e., students who have an undergraduate in a non-computing major and transited into the Software Engineering field through a graduate certificate.

The program is designed around the software development lifecycle and is founded on six pillar courses that describe the main software engineering phases. In particular, two of these courses are Requirements Engineering (SWE 6613) and Software Testing and Verification (SWE 6673). These two courses cover the two very important phases of software development: the initial phase where the needs of the project's stakeholders are identified, modeled, and analyzed, and the last phase that consists of the testing and verification of the produced software, representing the sought-after skills by the industry.

Another important course that was originally a core, but is now a (popular) elective, is Formal Methods (SWE 6883), which covers all the math-based techniques to formally analyze and verify software artifacts (e.g., specifications, models, code). This course equips MSSWE students with skills in developing safety-critical software.

As observed in our previous ALG-funded project (#392), by nature, software engineering is a fast-evolving discipline and not only books represent a considerable expense for the students, but they also tend to become obsolete very soon, making the expense often not worth it. Another major pedagogical downside is that such books might also "hold back" the content of a course that should be constantly updated to include new trends, techniques, and technologies.

For these reasons, in this project, we propose to develop free-cost materials for three major courses in the MSSWE that cover fundamental topics for the program, in pursuit of our strategic plan to transform the whole program into a no-cost program in the near future.

Following a similar approach to what was proposed in our previous ALG-funded project, we will collect and revise material available in the world wide web, identify relevant research papers, develop slides, videos, and lecture notes, and organize all the materials together to produce coherent and well navigable courses. Because of the nature of the disciplines, we will also include in the course materials to teach students how to identify new trends in the field, which were highly unlikely to experience using commercial books. This skill will be particular beneficial in the students' future career since the field will continue to evolve after their graduation. In addition to the team's expertise, the developing team will utilize t a curriculum forecasting tool, developed by our very own team (described further in Sustainability Plan section), to automatically detect the needs of updates in our courses' content.

After working on the initial courses of our program (SWE 6623 and SWE 6733) in previous ALG-funded project (#392), we decided to focus on SWE 6613 and 6673, because they cover fundamental topics for the MSSWE and crucial to the job market. Moreover, SWE 6883, even if it is only an elective, covers topics that, if always current, could make our students very competitive on the market.

Statement of Transformation

The majority of the existing books used in the three courses targeted by the project are fairly new (less than 10-15 years old), however, they suffer from many challenging issues. Some examples are as follows:

- The majority of these books (and similar books in the field) covers topics from a theoretical perspective rather than through practical examples and the use of new methodologies and techniques;
- While many software techniques and approaches exist and they need to be selected considering the many dimensions of the considered project, books usually present a traditional and single way of approaching a problem without pointers to additional techniques, and the information on how to adapt/modify the presented material depending on the setting of the project one is working on.

Moreover, when some foundations of math are needed (as in the case of SWE 6883) usually students are requested to adopt either too advanced or very obsolete books to bring themselves up to speed.

The main problems with the existing books can be summarized in threefold: (a) the material included becomes easily obsolete, while the books remain expensive; (b) the presentation is often not in line with the dynamic nature of the discipline, lacking practical and current real-world examples, and (c) foundational notions are often not presented sufficiently or contained in very old books, requiring students buying extra books.

These problems could potentially harm the students' learning, their motivation, and the perceived quality of the program to the public. The dynamic nature of software engineering requires more easily updatable material and a sustainable procedure to constantly update it. This proposal has the goal to create such needed material and outline a repeatable procedure to keep the content updated, as part of its sustainability plan.

Considering the active nature of the discipline, there are tons of available high-quality open sources in the world wide web, that are always updated and are aligned with research changes and industry needs. Unlike static material in books, online material is often offered in interactive ways aiming to increase the learner's engagement and participation in the learning process. In addition, different perspectives are also available when the material comes from different sources. If adopted, this can be used to help (our) students to improve their evaluation skills by comparing different views and approaches, creating true critical thinkers. Also, it could offer the opportunities to teach students how to identify the new trends when relevant technological changes are underway that may impact their future jobs.

- As we also noticed in previous ALG-funded project (#392), the main drawback of online material is that it is scattered and not always easy to find. In this project our goal is to identify the most relevant sources and organize the material in a one-stop manner to give the best learning experience of the subject matter to our students. This set of material will need to be updated periodically, and possibly reorganized, but the identification of a large set of trustworthy sources will support the process, that has the advantage to allow the faculty member responsible for the course to always be current and align with the industry.

The mathematical foundations needed for the three considered courses is well established and is not continuously changing. Nevertheless, also in this case, the existing books might not be the best fit for our students. Indeed, besides being expensive manuscripts, mathematical foundations books are written for a different audience and are in general either overwhelming or unnecessary for our students. Even if a lot of material is also available online, for foundation content, we plan to create new free interactive content. In this way, we can present it in the context of the course material will be used and this will help the students to appreciate more the importance of the covered topics.

Notice that in the case of foundation content developing fully new material is a sustainable option. Indeed, foundations are not subjected to become obsolete and so the produced material will not need constant updates.

Transformation Action Plan

The PIs will work together to transform the SWE programs through the following milestones already successfully followed to transform SWE 6623 and SWE 6733 in previous ALG-funded project (#392):

- Identification of the kind of material needed for the courses of interested – This step includes an analysis of the contents, the selection of different format per different topics, and the construction of a schedule coherent with the choice made.
- Research and selection of the materials used in the course – In this phase, we will analyze different sources and their reliability, and we will select the materials needed for the courses. The selection will comprise different types of material, such as readings, videos, open-source tools, and demos.
- Development of new material – This phase is devoted to complement the identified material with slides, lectures, and lecture notes. Foundations will be covered in this milestone.
- Development of project and assignments – In this step, we will create coursework assignment and project templates that are in line with the new material developed for the course. In addition, consultation with the industrial partners of the department's IAB will be considered in designing real-world coursework.
- Integration of the materials – In this phase, all the selected and created material will be integrated to obtain a well navigable course.
- Re-development of the courses in D2L Brightspace – The course based on the developed material will be developed in D2L Brightspace so that can be offered to the students both online and on campus.
- Analysis of the MSSWE to evaluate the possibility of a no-cost program – In this phase, we will analyze the data from the experiences in the current project and the previous one and t we will plan, if possible, the transformation of the remaining courses.

The developed course material will be made available to the public for adoption. With roots in the open source, we believe the material would be more sustainable and trustworthy in the community.

Quantitative & Qualitative Measures

We will collect both qualitative data to measure the level of satisfaction of the students on the effectiveness of the no-cost materials created, and quantitative data to measure how the changes in the material affect the success of the course not only in the courses changed by the project but also in the courses that has the affected courses as a prerequisite.

To measure the level of satisfaction of the students we will develop a questionnaire to collect the opinion of the students during and at the end of the course. The questionnaires will be distributed among both online and on campus students.

After the finals will ask to a sample of students to participate in a focus group to analyze how they believe the newly developed material affected their results in the course. The focus groups will allow a richer sample of data to be collected.

As done in our previous ALG-funded project (#392), to analyze the impact of the proposed changes on the students' success we will compare the success rate of the first two semesters in which the new courses are offered with the last four semesters in which the courses were offered. We will compare the obtained data using classic statistical indices. Within the project we will do the analysis only using a single offering of the new course. Moreover, outside the duration of the project, we will measure if and how the changes impacted on the success of the students in the courses that depend on the modified courses. This analysis will be based on the success rate, interviews with the instructors, and questionnaires for the students.

Timeline

10/01/2019 Complete the design of the structure of the material in terms of type of support (slides, notes, papers, videos, tools, …) for SWE 6673.

12/01/2019 Complete course material collection and design for SWE 6673 and integrate it in the existing course. SWE 6673 is taught in the Spring and the new material will be used in Spring 2020 offering.

1/01/2020 Define a survey procedure (needed data, surveys tools) to evaluate the effectiveness of the developed material through both qualitative and quantitative analysis.

2/01/2020 Complete the design of the structure of the material in terms of type of support (slides,notes, papers, videos, tools, …) for SWE 6613 and SWE 6883

4/01/2020 Complete course material collection and design for SWE 6613.

6/01/2020 Complete course material collection and design for SWE 6883.

7/01/2020 Complete analysis of the data collected for SWE 6673 (this analysis will be also used to "clean up" the survey tools, if needed).

8/01/2020 Complete the update SWE 6613 and SWE 6883. The courses will be offered in Fall 2020.

9/15/2020 Analysis of the graduate curriculum to identify the courses to consider for expanding the zero-cost initiative and obtaining a zero/low cost program.

11/15/2020 Complete analysis of the data, compile and submit project final report.

Budget
The requested funds are mainly to compensate (e.g., summer salary, needed professional development, ...) for the additional work that the investigators will need to do for the project in addition to the normal teaching load, research activities, or other service-related responsibilities. Each course included in this proposal will require at least 120 hours in developing the no-cost learning material and 30 hours in course assessment. Thus, the budget of this project is the following.

·Dr. Reza Parizi: $5000

·Dr. Paola Spoletini: $5000

Travel & Other Expense: $ 800 (expense for two team members to attend the Kick-off Meeting)

Sustainability Plan

Our programs follow a 3-year evaluation plan (i.e., each course is evaluated in a collegial way at least once every 3 years) that mimic the evaluation plan we used for our ABET accredited undergraduate program. In addition,

- Each course has a coordinator who collects the instructors and the students' feedback;
- The course instructor has to prepare a course evaluation to analyze the student's performance (in all the offered sections he/she teaches), which also include general consideration about the course, its goal, problems related to it, and possible improvement measures;
- Each course is evaluated by students through a curse evaluation form that include also evaluation on the provided material.

These mechanisms are already in place and provide the information needed to evaluate the course content and update it in a continuous way. The course coordination is distributed fairly among faculty members, so this should not overload any faculty member that was already invested as responsible for a set of courses before the introduction of zero-cost courses.

On top of this, in the last year the PIs have been working on a "forecasting" tool that in an adaptive and automatic way could notify instructors when the content of their courses needs changes or revamping. This approach is based on an analysis of the data collected automatically from the world wide web. The initially developed prototype is still in a very embryonal state, but it is already useful. During the project we will keep working on it and will prescribe plans how to use it in the sustainable plan to keep the course content updated.

The developed course material will be made available to the public for adoption and we plan to publish all the produce material and to present at meetings and conferences our experience with zero-cost requirements engineering courses.

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.
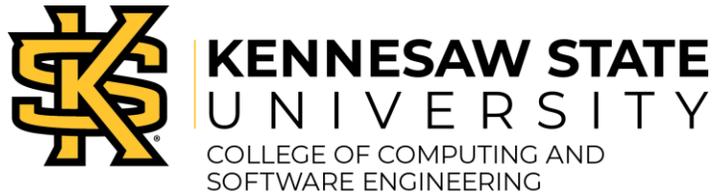
September 16, 2019

ALG Grant Committee University System of GA
Re: Support of Dr. Spoletini and Dr. Parizi's ALG project proposal

Dear Colleagues:

This letter is in support of the proposal "**Fostering Book-independent Software Testing and Verification in MS Software Engineering Education**" submitted by the Department of Software Engineering and Game Development (SWEGD) at Kennesaw State University.

As an Associate Dean in the College of Computing and Software Engineering (CCSE), I clearly see the need for bringing down the cost of education. The CCSE has been a supporter of the ALG Grant initiative since round one (round 1 #42). Several faculty members in the College have successfully used ALG grants to develop excellent courses with no-cost to students study materials and almost all the courses in the IT curriculum use open education resources (OER) developed by the CCSE faculty. The success of the previous ALG grants encouraged CCSE faculty to develop this new ALG grant proposal to save students even more money.

The SWEGD department offers both undergraduate and graduate programs in Software Engineering (SWE) with a variety of SWE-centric courses from Introduction to Software Engineering to more advanced topics in the field. Majority of the SWE core courses in the programs require students purchasing expensive textbooks. As a remedy, the proposed initiative project will provide a massive cut on learning expenses to students by replacing expensive textbooks with CCSE developed OER for SWE 6613 Requirements Engineering, SWE 6673 Software Testing and Verification, and SWE 6883 Formal Methods in Software Engineering.

The proposal is solid: the authors have pledged collaborative support for content analysis, development of new materials, and assessment of the relevant courses with the industrial partners of the department's IAB. This approach would help ensure that the proposed contents not only will be affordable to students but also make them sustainable for hands-on learning grounded in real-world applications.

I strongly believe that this new ALG proposal will have the same student satisfaction and success that the previous ALG grants did. Thank you for your consideration of this proposal. If there is any further information I can supply, please do not hesitate to contact me at (470) 578-3813 or speltsve@kennesaw.edu.

Sincerely,
Svetlana Peltsverger, Ph.D., CISSP
Associate Dean in the College of Computing and Software Engineering
Professor of Information Technology

Affordable Learning Georgia

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

Notes

- The proposal form and narrative .docx file is for offline drafting and review. Submitters must use the InfoReady Review online form for proposal submission.
- The only way to submit the official proposal is through the online form in Georgia Tech's InfoReady Review. The link to the online application will on the Round 15 RFP Page in July 2019.
- The italic text provided below is meant for clarifications and can be deleted.

Applicant, Team, and Sponsor Information

*The **applicant** is the proposed Project Lead for the grant project. The **submitter** is the person submitting the application (which may be a Grants Officer or Administrator). The submitter will often be the applicant – if so, leave the submitter fields blank.*

Institution(s)	Kennesaw State University
Applicant Name	Paola Spoletini
Applicant Email	pspoleti@kennesaw.edu
Applicant Phone #	470-578-3811
Applicant Position/Title	Professor
Submitter Name	Paola Spoletini
Submitter Email	pspoleti@kennesaw.edu
Submitter Phone #	470-578-3811
Submitter Position	Professor

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	Paola Spoletini	pspoleti@kennesaw.edu
Team Member 2	Reza Parizi	rparizi1@kennesaw.edu

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

Dr. Svetlana Peltsverger Associate Dean in the College of Computing and Software Engineering Professor of Information Technology Kennesaw State University

Project Information and Impact Data

Priority Category / Categories	*None*
Requested Amount of Funding	$10,800
Course Names and Course Numbers	Requirements Engineering (SWE 6613), Software Testing and Verification (SWE 6673), Formal Methods (SWE 6883)
Final Semester of Project	*Fall 2020*
Average Number of Students Per Course Section Affected by Project	*45-65, 45, 20*
Average Number of Sections Affected by Project in One Academic Year	1-2, 1, 1
Total Number of Students Affected by Project in One Academic Year	90
Average Number of Students Affected per Summer Semester	*0-20*
Average Number of Students Affected per Fall Semester	45
Average Number of Students Affected per Spring Semester	65
Original Required Commercial Materials	[1]. Software Requirements, Third Edition by Karl E. Wiegers, Microsoft Press, 2013 ISBN: 978-0-7356-7966-5 $ 49.99 https://www.microsoftpressstore.com/store/software-requirements-9780735679665 [2]. More About [2] Software Requirements: Thorny Issues and Practical Advice by Karl E. Wiegers, Microsoft Press, 2005 ISBN: 978-0-7356-2267-8 $39.99 https://www.microsoftpressstore.com/store/more-about-software-requirements-thorny-issues-and-9780735622678 [3]. The Software Requirements [3]Memory Jogger: A Pocket Guide to Help Software And Business. Teams Develop and Manage Requirements by Ellen Gottesdiener, GOAL/QPC, ISBN: 978-1-57681-060-6 $18.65 https://www.amazon.com/Software-Requirements-Memory-Jogger-Gottesdiener/dp/B01FJ1CY7Q [4]. Software Testing and Analysis: Process, Principles

	and Techniques By Mauro Pezzè, Michal Young Wiley, 2008 ISBN : 978-0-471-45593-6 $ 69.09 https://www.amazon.com/Software-Testing-Analysis-Principles-Techniques/dp/0471455938 [5]. An Introduction to Discrete Mathematics, Formal System Specification, and Z, Second Edition, 1992, By D. C. Ince, Oxford University Press, 1992, ISBN: 0-19-853836-7 $124.95 https://global.oup.com/academic/product/an-introduction-to-discrete-mathematics-formal-system-specification-and-z-9780198538363?cc=us&lang=en& [6]. The Object Constraint Language, Second Edition: Getting Your Models Ready for MDA, 2003, Jos Warmer and Anneke Kleppe, Addison-Wesley, Pearson Education ISBN: 978-0-321-17936-4 $44.99 https://www.amazon.com/Object-Constraint-Language-Getting-Models/dp/0321179366 .
Total Price of Original Required Materials Per Student	*$347.66*
Post-Project Cost Per Student	*$0*
Post-Project Savings Per Student	*$347.66*
Projected Total Annual Student Savings Per Academic Year	*$31,000*
Using OpenStax Textbook?	*No*

Narrative Section

1. Project Goals

The Master of Science in Software Engineering (MSSWE) at Kennesaw State University (KSU) is a very successful growing program with around 90 enrolled students in 2019. The MSSWE can be taken on campus, online, or combining the two modalities. The program welcomes not only regular students with an undergraduate in a computing discipline, but also career changers, i.e., students who have an undergraduate in a non-computing major and transited into the Software Engineering field through a graduate certificate.

The program is designed around the software development lifecycle and is founded on six pillar courses that describe the main software engineering phases. In particular, two of these courses are Requirements Engineering (SWE 6613) and Software Testing and Verification (SWE 6673). These two courses cover the two very important phases of software development: the initial

phase where the needs of the project's stakeholders are identified, modeled, and analyzed, and the last phase that consists of the testing and verification of the produced software, representing the sought-after skills by the industry.

Another important course that was originally a core, but is now a (popular) elective, is Formal Methods (SWE 6883), which covers all the math-based techniques to formally analyze and verify software artifacts (e.g., specifications, models, code). This course equips MSSWE students with skills in developing safety-critical software.

As observed in our previous ALG-funded project (#392), by nature, software engineering is a fast-evolving discipline and not only books represent a considerable expense for the students, but they also tend to become obsolete very soon, making the expense often not worth it. Another major pedagogical downside is that such books might also "hold back" the content of a course that should be constantly updated to include new trends, techniques, and technologies.

For these reasons, in this project, we propose to develop free-cost materials for three major courses in the MSSWE that cover fundamental topics for the program, in pursuit of our strategic plan to transform the whole program into a no-cost program in the near future.

Following a similar approach to what was proposed in our previous ALG-funded project, we will collect and revise material available in the world wide web, identify relevant research papers, develop slides, videos, and lecture notes, and organize all the materials together to produce coherent and well navigable courses. Because of the nature of the disciplines, we will also include in the course materials to teach students how to identify new trends in the field, which were highly unlikely to experience using commercial books. This skill will be particular beneficial in the students' future career since the field will continue to evolve after their graduation. In addition to the team's expertise, the developing team will utilize t a curriculum forecasting tool, developed by our very own team (described further in Sustainability Plan section), to automatically detect the needs of updates in our courses' content.

After working on the initial courses of our program (SWE 6623 and SWE 6733) in previous ALG-funded project (#392), we decided to focus on SWE 6613 and 6673, because they cover fundamental topics for the MSSWE and crucial to the job market. Moreover, SWE 6883, even if it is only an elective, covers topics that, if always current, could make our students very competitive on the market.

2. Statement of Transformation

The majority of the existing books used in the three courses targeted by the project are fairly new (less than 10-15 years old), however, they suffer from many challenging issues. Some examples are as follows:

- The majority of these books (and similar books in the field) covers topics from a theoretical perspective rather than through practical examples and the use of new methodologies and techniques;

- While many software techniques and approaches exist and they need to be selected considering the many dimensions of the considered project, books usually present a traditional and single way of approaching a problem without pointers to additional techniques, and the information on how to adapt/modify the presented material depending on the setting of the project one is working on.

Moreover, when some foundations of math are needed (as in the case of SWE 6883) usually students are requested to adopt either too advanced or very obsolete books to bring themselves up to speed.

The main problems with the existing books can be summarized in threefold: (a) the material included becomes easily obsolete, while the books remain expensive; (b) the presentation is often not in line with the dynamic nature of the discipline, lacking practical and current real-world examples, and (c) foundational notions are often not presented sufficiently or contained in very old books, requiring students buying extra books.

These problems could potentially harm the students' learning, their motivation, and the perceived quality of the program to the public. The dynamic nature of software engineering requires more easily updatable material and a sustainable procedure to constantly update it. This proposal has the goal to create such needed material and outline a repeatable procedure to keep the content updated, as part of its sustainability plan.

Considering the active nature of the discipline, there are tons of available high-quality open sources in the world wide web, that are always updated and are aligned with research changes and industry needs. Unlike static material in books, online material is often offered in interactive ways aiming to increase the learner's engagement and participation in the learning process. In addition, different perspectives are also available when the material comes from different sources. If adopted, this can be used to help (our) students to improve their evaluation skills by comparing different views and approaches, creating true critical thinkers. Also, it could offer the opportunities to teach students how to identify the new trends when relevant technological changes are underway that may impact their future jobs.

- As we also noticed in previous ALG-funded project (#392), the main drawback of online material is that it is scattered and not always easy to find. In this project our goal is to identify the most relevant sources and organize the material in a one-stop manner to give the best learning experience of the subject matter to our students. This set of material will need to be updated periodically, and possibly reorganized, but the identification of a large set of trustworthy sources will support the process, that has the advantage to allow the faculty member responsible for the course to always be current and align with the industry.

The mathematical foundations needed for the three considered courses is well established and is not continuously changing. Nevertheless, also in this case, the existing books might not be the best fit for our students. Indeed, besides being expensive manuscripts, mathematical foundations books are written for a different audience and are in general either overwhelming or unnecessary for our students. Even if a lot of material is also available online, for foundation content, we plan

to create new free interactive content. In this way, we can present it in the context of the course material will be used and this will help the students to appreciate more the importance of the covered topics.

Notice that in the case of foundation content developing fully new material is a sustainable option. Indeed, foundations are not subjected to become obsolete and so the produced material will not need constant updates.

3. Transformation Action Plan

The PIs will work together to transform the SWE programs through the following milestones already successfully followed to transform SWE 6623 and SWE 6733 in previous ALG-funded project (#392):

- Identification of the kind of material needed for the courses of interested – This step includes an analysis of the contents, the selection of different format per different topics, and the construction of a schedule coherent with the choice made.

- Research and selection of the materials used in the course – In this phase, we will analyze different sources and their reliability, and we will select the materials needed for the courses. The selection will comprise different types of material, such as readings, videos, open-source tools, and demos.

- Development of new material – This phase is devoted to complement the identified material with slides, lectures, and lecture notes. Foundations will be covered in this milestone.

- Development of project and assignments – In this step, we will create coursework assignment and project templates that are in line with the new material developed for the course. In addition, consultation with the industrial partners of the department's IAB will be considered in designing real-world coursework.

- Integration of the materials – In this phase, all the selected and created material will be integrated to obtain a well navigable course.

- Re-development of the courses in D2L Brightspace – The course based on the developed material will be developed in D2L Brightspace so that can be offered to the students both online and on campus.

- Analysis of the MSSWE to evaluate the possibility of a no-cost program – In this phase, we will analyze the data from the experiences in the current project and the previous one and t we will plan, if possible, the transformation of the remaining courses.

The developed course material will be made available to the public for adoption. With roots in the open source, we believe the material would be more sustainable and trustworthy in the community.

4. Quantitative and Qualitative Measures

We will collect both qualitative data to measure the level of satisfaction of the students on the effectiveness of the no-cost materials created, and quantitative data to measure how the changes in the material affect the success of the course not only in the courses changed by the project but also in the courses that has the affected courses as a prerequisite.

To measure the level of satisfaction of the students we will develop a questionnaire to collect the opinion of the students during and at the end of the course. The questionnaires will be distributed among both online and on campus students.

After the finals will ask to a sample of students to participate in a focus group to analyze how they believe the newly developed material affected their results in the course. The focus groups will allow a richer sample of data to be collected.

As done in our previous ALG-funded project (#392), to analyze the impact of the proposed changes on the students' success we will compare the success rate of the first two semesters in which the new courses are offered with the last four semesters in which the courses were offered. We will compare the obtained data using classic statistical indices. Within the project we will do the analysis only using a single offering of the new course. Moreover, outside the duration of the project, we will measure if and how the changes impacted on the success of the students in the courses that depend on the modified courses. This analysis will be based on the success rate, interviews with the instructors, and questionnaires for the students.

5. Timeline

10/01/2019 Complete the design of the structure of the material in terms of type of support (slides, notes, papers, videos, tools, …) for SWE 6673.

12/01/2019 Complete course material collection and design for SWE 6673 and integrate it in the existing course. SWE 6673 is taught in the Spring and the new material will be used in Spring 2020 offering.

1/01/2020 Define a survey procedure (needed data, surveys tools) to evaluate the effectiveness of the developed material through both qualitative and quantitative analysis.

2/01/2020 Complete the design of the structure of the material in terms of type of support (slides, notes, papers, videos, tools, …) for SWE 6613 and SWE 6883

4/01/2020 Complete course material collection and design for SWE 6613.

6/01/2020 Complete course material collection and design for SWE 6883.

7/01/2020 Complete analysis of the data collected for SWE 6673 (this analysis will be also used to "clean up" the survey tools, if needed).

8/01/2020 Complete the update SWE 6613 and SWE 6883. The courses will be offered in Fall 2020.

9/15/2020 Analysis of the graduate curriculum to identify the courses to consider for expanding the zero-cost initiative and obtaining a zero/low cost program.

11/15/2020 Complete analysis of the data, compile and submit project final report.

6. Budget

The requested funds are mainly to compensate (e.g., summer salary, needed professional development, ...) for the additional work that the investigators will need to do for the project in addition to the normal teaching load, research activities, or other service-related responsibilities. Each course included in this proposal will require at least 120 hours in developing the no-cost learning material and 30 hours in course assessment. Thus, the budget of this project is the following.

- Dr. Reza Parizi: $5000
- Dr. Paola Spoletini: $5000

Travel & Other Expense: $ 800 (expense for two team members to attend the Kick-off Meeting)

7. Sustainability Plan

Our programs follow a 3-year evaluation plan (i.e., each course is evaluated in a collegial way at least once every 3 years) that mimic the evaluation plan we used for our ABET accredited undergraduate program. In addition,

- Each course has a coordinator who collects the instructors and the students' feedback;

- The course instructor has to prepare a course evaluation to analyze the student's performance (in all the offered sections he/she teaches), which also include general consideration about the course, its goal, problems related to it, and possible improvement measures;

- Each course is evaluated by students through a curse evaluation form that include also evaluation on the provided material.

These mechanisms are already in place and provide the information needed to evaluate the course content and update it in a continuous way. The course coordination is distributed fairly among faculty members, so this should not overload any faculty member that was already invested as responsible for a set of courses before the introduction of zero-cost courses.

On top of this, in the last year the PIs have been working on a "forecasting" tool that in an adaptive and automatic way could notify instructors when the content of their courses needs changes or revamping. This approach is based on an analysis of the data collected automatically from the world wide web. The initially developed prototype is still in a very embryonal state, but it is already useful. During the project we will keep working on it and will prescribe plans how to use it in the sustainable plan to keep the course content updated.

The developed course material will be made available to the public for adoption and we plan to publish all the produce material and to present at meetings and conferences our experience with zero-cost requirements engineering courses.

Note: Letter of Support (attached)

The Associate Dean, Dr. Peltsverger, wrote the support letter as representative of the department (and college) instead of and under suggestion of the Department Chair, Dr. Yenduri (temporarily absent for a medical leave).