



## Work in Progress: One Approach to Software Engineering Project Selection for Small Student Populations

**Dr. Paul A Bender, Ohio Dominican University**

Paul Bender is an Assistant Professor of Software Engineering at Ohio Dominican University in Columbus, OH. He previously taught Computer Science at McNeese State University in Lake Charles, LA. He holds a B.S. in Computer Science from Missouri State University, Springfield, MO, an M.S. in Computational Mathematics from Ohio University, Athens, OH, and a Ph.D. in Computer Science and Engineering from Wright State University, Dayton, OH. These degrees were completed in 1998, 2004, and 2008, respectively. He is a member of the ACM, IEEE, and ASEE.

Dr. Bender's research interests include various topics in Operating Systems and Networking, including adhoc networks, real time systems, multimedia communications, and system security. The focus of his current research is on the application of test driven and behavior driven development to distributed real time sensor/actuator networks.

# **Work in Progress: One approach to Software Engineering project selection for small student populations**

Paul Bender

benderp2@ohiodominican.edu

Division of Mathematics, Computer, and Natural Sciences

Ohio Dominican University

## **Abstract**

Software Engineering is a discipline that by its nature expects students to engage in group work. Our Software Engineering program culminates with a senior project course that is intended to provide students with an opportunity to see a software project through one or more increments that can be delivered to the customer. In addition, it is desirable for students to gain real world experience working in a group on a software project for a real customer.

Ideally, groups will consist of 3 to 5 students in the senior project course, however, since our program is small, we may have fewer than 3 students enrolled in the course during any given offering. The goal of this work is to find a sustainable method of providing students with opportunities to work on group projects for outside entities, even when the enrollment in the capstone course precludes forming groups of the desired size.

Our initial investigation is evaluating the effectiveness of utilizing socialcoder.org as a source for student projects. socialcoder.org is a website that seeks to match volunteer developers with projects for non-profit organizations<sup>7</sup>. By utilizing socialcoder.org, we provide an opportunity for students to work in a team that includes individuals from outside the institution. Students also have an opportunity to work with a real customer and engage in a service learning project consistent with the university's mission.

This work examines two trials. The first trial had a single student participant and was quite successful. The second trial had 4 students participate, but had mixed results.

## **Introduction**

At Ohio Dominican University, there are two computing programs, a small Computer Science program, with approximately 30 total students, and a small Software Engineering program with about 20 total students. The first students enrolled in the Software Engineering program in the fall of 2014. The program was created following the 2004 edition of the Association for Computing

Machinery (ACM) and IEEE Computer Society's joint Software Engineering Curriculum guidelines<sup>1</sup>. The program culminates in a 1 semester senior capstone course, which follows the description in the guidelines, which reads as follows:

Provides students, working in groups, with a significant project experience in which they can integrate much of the material they have learned in their program, including matters relating to requirements, design, human factors, professionalism, and project management.

The university has also made the determination that projects in this course will be student selected, with guidance from the instructor.

Several issues arise with the small student population when faced with the requirements of the description above. Two of these seem to be most important here.

First, because of the small student population, we cannot justify offering the class every semester. The course is currently offered in the fall semester. Occasionally we are required to teach students who, through no fault of their own, must complete the course in the spring semester. When this occurs, the group aspect of the required project is difficult to accomplish with enrolled students taking on all of the work.

Second, even when students reach the capstone course as a group, the groups are small, 3 or 4 students. While a group of 3 students is considered the minimum viable project group size, the students generally proceed through the program as a cohort, and each student has therefore completed the pre-requisite courses with the group of students with whom they enter the capstone course. While it is possible to have the students continue to work with the same group of students, it is highly desirable to expose the students to a wider range of individuals, both as developers and customers, than is possible by choosing a group from the small cohort available.

We have set the following goals for the project selection method utilized in the capstone course:

- Provide a sustainable method for providing capstone projects to our student population.
- Provide an opportunity for students to develop software for a real customer.
- Provide an opportunity for students to develop software with outside individuals, who may provide additional mentorship opportunities.
- Provide the students with an opportunity to work on a project where there is no presumption that the project will be successfully completed.
- Provide an opportunity for service learning, consistent with the mission of the university.

Many papers, such as<sup>2,3,4,5</sup> address utilizing Free and Open Source Software as the basis for the capstone course. A few of these papers, such as<sup>4</sup>, add an aspect of service learning to the projects. None of these papers address directly the issue of providing projects to small groups of students, particularly individual students, that meet these goals.

This paper presents a work in progress solution to the process of meeting our goals. To date, there have been two experiments performed, an Initial Trial with a single student in the spring 2017

semester and a regular class offering in the fall 2017 semester. These experiments are described in the next two sections.

## **Initial trial**

During the fall 2016 term, the author was informed that a single student in the Software Engineering program was scheduled to graduate in the spring 2017 term. This student would need to have the capstone course in order to graduate. The first regular offering of the course was scheduled for fall 2017. Immediately, we begin planning for how to offer a group experience for this single student.

At about the same time, the author was made aware of the Social Coder project (<https://socialcoder.org>) because of a partnership between Social Coder and the ACM<sup>6,7</sup>. The social coder organization is an organization dedicated to connecting volunteer programmers with charity groups for specific goal-oriented projects.

The confluence of these events was a significant factor in determining how the student would complete the course. At the beginning of the spring 2017 term, the student was instructed to create an account on the Social Coder website and choose a project, which was then approved by the instructor. The student made periodic verbal reports to the instructor about his project during the term and completed the term with a short paper about the experience.

Two statements made by the student in his paper indicated to the author that this might be a viable option for providing a meaningful experience to students in the capstone course.

First, the student mentioned he was required to learn programming languages he had never learned before, PHP and HTML5, for the project to be completed. Of learning PHP, he specifically stated:

I had to work hand to hand with our volunteers as well as on my own in order to get some PHP knowledge that would be beneficial for us.

Which indicated he experienced the desired mentorship aspect of working with external individuals to complete a project.

Additionally, he stated of his required programming language learning experience

It also motivated me to always keep up with technology because what we use today will not be the same that we will use tomorrow and we need to be prepared for it before it even happens.

Which indicated the student now has first hand experience with the goal of creating life-long learners that we all hope to accomplish.

Second, the student spoke of the difficulty of communicating with developers located around the globe

Since we were located in different parts of the world; communication was also an issue, it was hard to get fast feedback having people in China, Japan, India, and

Malaysia.

Overall it was determined that the student successfully met the objectives set forth by the author and the University for the capstone course.

### **Experimenting in a regular term**

Based on the experience with a single student the previous term, it was determined that a slightly modified version of the initial trial would be offered to students during the capstone course's first official offering in the fall 2017 term. For this offering, 4 students were enrolled in the course.

As with the initial trial, students were instructed to sign up for the socialcoder website and apply for a project which they would accept with the consent of the instructor. Differing from the initial trial, the students enrolled in the course had weekly meetings to report progress to the instructor, and the class as a whole. Students also completed midterm and final presentations of their work.

In order to collect less anecdotal evidence of how well Social Coder provided for the needs of the course, students completed a survey covering several aspects of the project selection process and the project itself. The next two sections discuss the student's experiences with socialcoder.org and their experiences with the projects selected via socialcoder.org.

### **Experiences with socialcoder.org**

The student survey included several questions about the experience students had with socialcoder. The results of the numeric questions are presented in Table 1.

Question	Student				% Agree or	Average
	1	2	3	4	Strongly Agree	
Projects described on socialcoder.org sound interesting (1 Strongly Disagree, 5 Strongly Agree)	4	2	3	4	50	
Organizations using socialcoder.org are worthwhile charitable organizations (1 Strongly Disagree, 5 Strongly Agree)	3	4	5	4	75	
How many projects did you apply to on socialcoder.org?	5	9	3	4		5.25
How many projects were you accepted to on socialcoder.org?	0	1	1	4		1.5

Table 1: Responses to Student Survey Questions about Social Coder

The survey results indicate that more students agree with the statement that the projects sound interesting and agree that the organizations involved were worthwhile charitable organizations, than disagree with those statements. However, the acceptance rate of students into projects was very low, with one student not accepted into any project at all, and only one student accepted into more than one project.

Additionally, students were asked two open ended questions.

What reason(s) would you give to recommend students participate in projects found on socialcoder.org?

What reason(s) would you give to recommend students not participate in projects found on socialcoder.org?

Students generally answered the first question with a variation of "it is a potential source of projects where you can gain experience".

In the second question, the students made notes about the relative lack of project choices, and the lack of communication from the project leaders.

The question of why there is a contradiction between these two statements stems from two factors. The first factor was simply the number of projects that the students could apply to. While students were allowed to view approximately 20 projects, fewer than 10 were accepting applications.

The second factor actually was a more positive result, from an experiential point of view. While the students didn't appreciate the outcome, students gained first hand experience with projects that were relatively disorganized. This can be seen by questions in the second part of the survey, discussed in the next section.

### The project experience

Students also answered several questions about their experience with the projects selected via socialcoder. Since one student was not selected to a project from socialcoder, we were required to use an alternate project selection method. This student did not participate in this portion of the survey. The results of the numeric questions are presented in Table 2.

Question	Student		
	2	3	4
Estimate how far along the project was at the time of acceptance (1 Formational, 5 Established)	4	4	2
The project was well organized (1 Strongly Disagree, 5 Strongly Agree)	1	4	2
The organization understood what they wanted out of the project (1 Strongly Disagree, 5 Strongly Agree)	4	4	4
The organization was easy to work with (1 Strongly Disagree, 5 Strongly Agree)	3	3	2

Table 2: Responses to Student Survey Questions about the Project

In the question of the project development phase, most students found the projects they were accepted to were in the initial development phase, after design work had been completed and that the organizations knew what they wanted out of the project. The students found the projects to be somewhat poorly organized and hard to communicate with.

Additionally, students were asked two open ended questions about the project.

What existing technical expertise did you feel you had for the projects you were accepted to?

What new technical expertise did you feel you needed to learn for the projects you were accepted to?

In answer to these questions, most students felt that they were coming into the project with basic programming and design skills, but they were going to be required to learn a new programming language and/or a new software development stack. Students also mentioned needing to learn some software development tools, git in particular, in order to complete the project.

### **Alternate project selection method**

To provide the 4th student in class with a meaningful project experience, the student was allowed to pick an open source project of interest from github.com. The project was approved by the instructor before the student started working on it.

While the project selected did not have the direct social benefits that projects from socialcoder.org have, this did meet the goal of allowing the student to work on a team with outside individuals. While no objective data was obtained for this student, the student was able to contribute to the project effectively.

### **Discussion**

While the initial trial was deemed successful, the subsequent experiment during a regular course offering was at least a partial failure.

Students during the regular course offering found it difficult to find suitable projects, and for that reason alone, socialcoder.org fails to fulfill our objectives. In particular, we have not shown that socialcoder.org provides a sustainable method of providing capstone projects to our students.

On a positive note, students were able to experience working with a real customer, and both good and bad aspects of customer interaction. Students were also required to work with developers from outside the institution. These two interactions included determining the expectations of the customer as well as the organizational structure of the project.

Students were also exposed to a real example of why one needs to be a life-long learner when working in the computer industry. Each student who was accepted to a project from socialcoder.org mentioned the need to learn some piece of technology in order to participate in the project.

Perhaps the biggest takeaway from this experiment is that projects need to be more curated by the instructor than utilizing socialcoder.org as a project source allows. Project curation does not

ensure that students will successfully complete projects, but it does ensure that every student will be able to participate in a project. For the next iteration of the course, we will again have 4 students enrolled. The curated projects will be a mixture of open source projects and projects that aid the university in furthering its mission.

## References

- [1] The Joint Task Force on Computing Curricula. Curriculum guidelines for undergraduate degree programs in software engineering. Technical report, New York, NY, USA, 2004.
- [2] Michelle Craig, Ted Kirkpatrick, Shealen Clare, and Amgine Saewyc. Undergraduate capstone open-source projects. In *Proceedings of the Seventeenth Western Canadian Conference on Computing Education, WCCCE '12*, pages 57–58, New York, NY, USA, 2012. ACM. ISBN 978-1-4503-1407-7. doi: 10.1145/2247569.2247589. URL <http://doi.acm.org/10.1145/2247569.2247589>.
- [3] Kwok-Bun Yue, Zahabia Damania, Raunaq Nilekani, and Krishani Abeysekera. The use of free and open source software in real-world capstone projects. *J. Comput. Sci. Coll.*, 26(4):85–92, April 2011. ISSN 1937-4771. URL <http://dl.acm.org/citation.cfm?id=1953573.1953587>.
- [4] Stoney Jackson and Heidi Ellis. Supporting hfoss using scrum in a capstone course. *SIGCAS Comput. Soc.*, 45(2):36–37, July 2015. ISSN 0095-2737. doi: 10.1145/2809957.2809968. URL <http://doi.acm.org/10.1145/2809957.2809968>.
- [5] Judith Bishop, Carlos Jensen, Walt Scacchi, and Arfon Smith. How to use open source software in education. In *Proceedings of the 47th ACM Technical Symposium on Computing Science Education, SIGCSE '16*, pages 321–322, New York, NY, USA, 2016. ACM. ISBN 978-1-4503-3685-7. doi: 10.1145/2839509.2844665. URL <http://doi.acm.org/10.1145/2839509.2844665>.
- [6] ACM. Acm and socialcoder: Partnership for positive impact through computing, 2016. URL <https://www.acm.org/membership/social-coder>.
- [7] Social Coder. Social coder - software development for good causes. URL <https://socialcoder.org/Home/Index>.