How to Teach Software Engineering for Societal and Social Impact

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Abstract

In this panel, the presenters will discuss their collective experience of teaching software engineering courses and/or running software engineering projects that help students learn about and experience the impact of computing on society and the social good. While the benefits of practical experience in software engineering are generally indisputable, the logistics and management of such projects are often discouraging for faculty, leading many to exclude live clients from software engineering courses. The presenters will demystify and discuss the realities of running client-oriented classes and projects in the contexts of our institutions, which vary greatly in size and student demographics and represent both public and private colleges. In particular, we will discuss various approaches used to identify, design, create, and evaluate software engineering projects for societal and social impact. Project duration ranges from one semester to two or more, and participation in team projects is modeled as pre-professional training, complete with software tools, interpersonal dynamics, and evaluation methods.

CCS Concepts

• **Social and professional topics → Computer science education**; **Software engineering education**.

Keywords

Software engineering; experiential learning; service learning; course projects; capstone projects; external project partners

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1 Summary

Pursuing a computer science degree is rarely viewed by students as a pathway to positive societal impact. Unlike engineering or healthcare, many computing graduates see their major primarily as a means to solve technical problems and develop software applications. It is essential that we teach computing as a field with significant potential to address many pressing social, environmental, and economic challenges. Computer Science Curricula 2023 [2] further emphasizes the importance of incorporating these topics throughout the entire curriculum.

This panel will specifically focus on software engineering (or similar) courses and projects that address various social good causes. We believe that incorporating service-learning projects with nonprofits and community organizations can help students better understand the real-world impact of computing solutions on their communities and overall human well-being. Furthermore, such initiatives can foster a cultural shift within departments and potentially broaden participation in the field.

Participants of this panel represent public and private institutions of various sizes serving demographically different populations. We will discuss various approaches and principles that we follow to help maximize student engagement with the course material, course projects, project partners, and the social causes they serve. Each of us tried different strategies due to the differences in our institutional context, prior experience, engagement with community partners, and different stakeholders.

The panelists will discuss course outcomes based on shared team goals and vision, including student identification with the major, an increased sense of belonging, and a reduction in inter-team stresses.

2 Panel Structure

Introduction (10 minutes): The panel moderator will provide context for the discussion, describing why it is important to expose students to the social and societal impacts of computing and the role of software engineering and courses in achieving this goal. Then, the moderator will introduce each panelist.

Panelist Statements (5 minutes each): Each panelist will briefly describe their background and relevant experience, while emphasizing their approach and practices of incorporating social and societal effects of computing into software engineering education.

Discussion (50 minutes): The moderator will welcome questions from the audience and facilitate the discussion among the panelists.

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We believe that the single most important question that we all are seeking answers to is

> How do you expose students to a broader spectrum of the project's social and societal impact beyond designing and coding relevant functionality?

We anticipate that the audience will agree that while the problems we are facing are common, there may not be a single universal solution to solving them. However, we hope that each member of the audience will be able to identify some actionable solutions that would resonate with them.

3 Position Statements

Amy Csizmar Dalal is a Professor of Computer Science at Carleton College, a private selective liberal arts college. Since 2005, she has taught the computer science capstone course, in which senior computer science majors work in teams of 4-6 over two academic terms on a software engineering project chosen by the faculty member; in a typical year, she teaches 3 such teams of students. She led her first community partner collaboration in 2015-2016, and has worked with 7 different community and campus organizations as project partners, as well as 2 humanitarian free and open source software projects (HFOSS), in projects involving 66 students. Two of these collaborations spanned multiple years, multiple project teams, and multiple faculty advisors, a model discussed in [1].

Because students are often creating software solutions for their community partners, who themselves are not technical experts nor have the time, expertise, and resources to maintain and troubleshoot these solutions, questions of maintenance and sustainability are top of mind. More recently, in considering and structuring projects with community partners, we engage with the following questions: a) How do you structure projects with community partners with sustainability of support in mind, once the course is over? b) How does this sustainability mindset influence the choice of community partners and/or the scoping of capstone projects? and c) Can multi-year collaborations help mitigate some of these issues? If so, what are effective strategies for structuring multi-year projects?

Patricia Morreale is a Professor of Computer Science at Kean University, a public urban Hispanic Serving Institution (HSI). For the past 10 years she has taught a software engineering course where, each fall, 6-9 student teams of 4-6 students identify and work with a client on a software engineering project. By the end of 2023, 48 projects had been completed by 226 students, with 26 project partners being non-profit or community organizations. As part of the course project, a goal is to develop students capable of inclusive design [6]. In addition to making sure the students identify projects of the correct size and scope, pedagogy on inclusive design is used, exploring how to engage students in thinking about their client and their team's needs and how to form student teams to promote and support inclusivity and inclusive software design.

Stan Kurkovsky is a Profesor of Computer Science at Central Connecticut State University (CCSU), a mid-size public university. Since 2014, he has been running CCSU Software Engineering Studio, which helps connect external project partners with local student teams. Every semester, the Studio works with 10-15 teams of 4-5 juniors and seniors. Typical software projects in the Studio run between 1 and 4 semesters, while students contribute to these projects through one or two relevant courses. By the end of spring 2024, the Studio had collaborated with over 50 project partners, 33 of which were non-profits and community organizations, with over 130 student teams contributing to their software projects. This experience resulted in a mature framework [5] for channeling these projects through the curriculum and supporting them with a broad set of small deliverables and other types of scaffolding [3, 4]. In light of this experience, some of the most thorny questions that the Studio is facing on a regular basis revolve around these themes: a) How to find good and reliable partners with meaningful projects? b) How to assess whether a project would be a good fit for the program and its students while meeting the criteria of serving the social good? and c) How to ensure continuous student engagement with the project?

Mikey Goldweber is a Professor of Computer Science at Denison University, a small, private, liberal arts institution. For the past 15 years Mikey has been involved in efforts to infuse social relevance in CS education, first as one of the founders of the Computing for the Social Good in CS Education (CSG-Ed) movement and later as a Board member and former chair of ACM SIGCAS, and as a CS2023[2] Steering Committee member. Previously, while at Xavier University, a small, private, Jesuit university, he oversaw decades of capstone projects and taught an open-ended problem-solving course focusing on addressing local community issues. The questions that Mikey has been focusing on include: a) How to practice responsible and ethical software engineering in a classroom setting; and b) Getting students to see beyond the technical problems to be solved and see the social implications of the systems they are creating.

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