Encouraging CS Students to Compute for Social Good Through Collaborative, Community-Engaged Projects

Extended Abstract

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ABSTRACT

Which pedagogical techniques better engage computer science (CS) students in computing for social good? We examine this question with students enrolled in classes using the Collaborating Across Boundaries to Engage Undergraduates in Computational Thinking (CABECT) pedagogical model, that pairs CS and non-CS courses with a community partner to propose solutions to a local problem. Pre- and post-tests of self-assessed concerns about civic responsibility, global responsibility, and local civic efficacy were administered to the students in a three-year long pedagogical experiment, which paired five CS courses with five journalism courses. While CS students were not statistically different from their journalism peers in pre-test measures of social and global responsibility, they lagged behind in local efficacy. In the post-test, CS students had significantly increased their sense of local efficacy to the extent that they were statistically indistinguishable from journalism students. Community-engaged learning projects, such as the one in the CABECT model, show great potential for attracting students to computing for social good.

CCS CONCEPTS

• **Applied computing → Education →** Collaborative learning

KEYWORDS

Civic Engagement, Computing for Social Good, Community-Engaged Learning

1 INTRODUCTION

Computing for social good (CSG) charges computer science (CS) educators to consider how students can use their disciplinary skills to improve social and environmental well-being. These questions are central to the Collaborating Across Boundaries to Engage Undergraduates in Computational Thinking (CABECT) pedagogical model, where CS classes were teamed with non-CS classes to develop solutions to a community-identified problem of determining levels of ground contamination on future build sites.

1.1 The Social Issue

Environmental testing and mitigation have made it increasingly difficult for Habitat for Humanity to build homes that are affordable for its target clients. In fact, Habitat for Humanity has turned down land donations because of the cost of testing and the potential liability for mitigation. The regional Executive Director of Habitat for Humanity asked for a computer-based system that would estimate the likelihood of contamination on any given plot of land, prior to expensive environmental testing.

1.2 The Pedagogical Model

CS and journalism classes were run separately with their own learning goals and associated assessments, but each contained assignments structured around the collaborative creation of a web-based system designed to provide accurate, accessible and comprehensive information on whether sites may be polluted. After being introduced to the collaborative project on the first day of class, students met jointly four times throughout the semester. At the initial meeting, the Executive Director from the local Habitat for Humanity chapter explained how the lack of accurate pollution information complicates their efforts to provide affordable housing. Students next met to brainstorm ideas to create, or improve existing, software modules that would help address the problem. Small groups of CS and journalism students continued to meet outside of class to continue working on the project. The journalism students were responsible for identifying credible data sources and creating content, while the CS students were responsible for the design and development of the computational solution. A third joint class involved a field trip to the neighborhood that Habitat for Humanity was working to redevelop. At the end of the semester, the students presented their software modules to the Executive Director of Habitat for Humanity, and other interested stakeholders.

2 THE STUDY

Student outcomes were measured through self-assessments in pre- and post-tests in five paired classes over four semesters. As seen in Table 1, in one semester, two courses from each discipline were included in the study; in all other semesters, only one course from each discipline was included. CS and journalism groups are non-

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equivalent, so a non-comparable groups experimental design was employed. Pre-tests were administered in person as paper surveys on the first day of class, following an explanation of the project and a review of human subjects' protection. Post-tests were administered electronically using Qualtrics software.

Table 1: Collaborating Classes, by Semester

Semester	CS Course	Journalism Course
Spring 2013	Software Engineering	Blogging and Social Media
Fall 2013	Database Systems	Health and Environmental Journalism
	Software Engineering	News Games
Spring 2014	Software Engineering	Future of the News
Fall 2014	Software Engineering	Health and Environmental Journalism
Spring 2015	Software Engineering	Blogging and Social Media

2.1 Measurement

Items were adapted from Mabry [3], Lerner et al [2], and Bobek et al [1] scales measuring Civic Attitudes (5 items), Social Conscience (5 items), and Positive Civic Attitudes (7 items). Factor Analysis identified two factors and one item that did not load. An index was created from each factor to measure Social Responsibility and Local Efficacy; both had high internal reliability in both pre- and post-tests. The item that did not load was kept as a single item (Global Efficacy).

Social Responsibility included items such as, "People, regardless of whether they've been successful or not, ought to help others" and "It is important to help others even if you don't get paid." *Global Efficacy* included the item "I feel that I can make a difference in the world." *Local Efficacy* included items such as, "I believe I can make a difference in my community," "I often think about doing things so that people in the future can have things better" and "It is important to me to contribute to my community and society."

2.2 Findings

In the pre-test, analysis of variance (ANOVA) indicates that students in the computer science and journalism classes were statistically different ONLY in the local efficacy index ($F = 18.817$, $p = .000$). In the post-test, analysis of variance (ANOVA) indicates that students in the computer science classes were no longer statistically different from the students in the journalism classes. Paired sample t-tests also indicate that the only statistically significant difference from pre-test to post-test is in the local efficacy index ($t = -9.982$, $p = .000$).

Participation in these courses had little effect on how the students viewed social responsibility generally or how they felt about the difference they could make in the world abstractly. At the same time, all students increased their sentiment of local efficacy, indicating that after participating in the collaboration, they increased their sense of responsibility for, and ability to make a difference in, their immediate communities (see Table 2). CS students, who reported a much lower sense of local efficacy than the students in the journalism classes at the outset, statistically demonstrated the same levels of local efficacy as their journalism peers in the post-test. The pedagogical model thus had a positive impact on all students in terms of increasing their sense of local efficacy, but this impact was much stronger among CS students.

Table 2: Mean Changes from Pre-to Post-test, by discipline

Mean Changes	CS	JPW	Total
Social Responsibility	+.05	+.07	+.03
Global Efficacy	-.05	-.29	-.10
Local Efficacy	+12.81	+5.88	+11.22

This change was achieved even while evidence of computational thinking increased among all groups of students. On all measures of computational thinking, all measures increased from pre- to post-test, with the only significant difference was that the mean change in "I can use abstractions" was statistically greater for students in computer science courses than in journalism courses ($F = 4.546$, $p = .038$). See [4, 5] for a thorough examination of the computational learning goals in this project, and more details of the study.

3 DISCUSSION

Computing for Social Good (CSG) in the undergraduate CS curriculum should provide opportunities for students to apply their developing skills to community-identified problems in need of computing solutions. The CABECT experiment demonstrates that while community-engaged learning may have limited effect on abstract ideas about social and global responsibility, when CS students participate in these activities, they develop a stronger sense of their own abilities to make positive changes in their communities.

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REFERENCES

[1] Bobek, D., Zaff, J., Li, Y., and Lerner R.M. (2009) Cognitive, emotional, and behavioral components of civic action: Towards an integrated measure of civic engagement. Journal of Applied Developmental Psychology 30(5): 615-27.

[2] Lerner, P.M., Lerner, J.V., Almerigi, J., Theokas, C. Phelps, E., Gestodottir, S. et al (2005) Positive youth development, participation in community youth development programs, and community contributions of fifth grade adolescents: Findings from the first wave of the 4-H Study of Positive Youth Development. Journal of Early Adolescence 25 (1): 17-71.

[3] Mabry, J. B. (1998) Pedagogical variations and student outcomes in service-learning: How time, contact, and reflection matter. Michigan Journal of Community Service Learning 5: 32-47.

[4] Pearson, Kim, Monisha Pulimood, and Diane Bates. 2017. Collaborating Across Boundaries to Engage Journalism Students in Computational Thinking. Teaching Journalism and Mass Communications 6, 1: 77-91.

[5] Pulimood, S.M., Pearson, K. and Bates, D. C. 2016. A Study on the Impact of Multidisciplinary Collaboration on Computational Thinking. In Proc. of the 47th ACM Technical Symposium on Computer Science Education (ACM SIGCSE), Memphis, TN, March 2 – 5, 2016.