Why Should Computer and Information Science Programs Require Service Learning?

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ABSTRACT

Service learning—an educational experience in which students provide service to a community partner while learning content knowledge, professional skills, and critical thinking—can provide significant benefits to students and the community. We present survey results from 227 postsecondary students in computing to provide insights into their attitudes toward service learning, and how these relate to course-taking motivations and sense of civic duty. Based on the survey results, we argue that service learning should be required in an undergraduate computing major. However, we problematize this provocation based on three types of pitfalls: courses that do not prepare students to understand social contexts in which technical solutions are promoted, lack of resources for faculty teaching the courses, and the potential to harm both community partners and students.

CCS CONCEPTS

• Social and professional topics~Professional topics~Computing education~Computing education programs~Computer science education;

KEYWORDS: Service learning; Student attitudes toward civic duty; Course-taking motivations; Women in computing

1 Introduction

Service learning is an educational experience in which students provide service to a community partner while gaining content knowledge and professional and critical thinking skills. For example, students might develop mobile apps, mentor high school students, or install networks. In addition to content knowledge, service learning experiences—especially those in which students collaborate with a community partner—are considered a good opportunity for students to develop professional skills [8]. Scholars have also argued that to increase diversity in computing, CIS departments should increase service and civic engagement in their curricula [8, 10, 23, 28, 37] and incorporate personally meaningful, societally relevant curriculum [2, 3, 24, 25, 29, 35]. Yet most CIS undergraduate programs do not offer service learning courses or only offer them as electives, and the field of CIS education research has little information on students' perspectives toward service learning or the connection with students' goals, whether or not they have taken a course. To address this knowledge gap, we present here the results from a survey of 227 CIS students in which we investigate students' attitudes toward civic duty and community engagement, the appeal of service learning, motivations for taking courses, and for those few in the sample who have taken a service learning course, their perceptions and outcomes of participating.

2 Literature on Service Learning

Large, cross-disciplinary meta-analyses suggest that students grow as individuals, professionals, and as members of a civil society by participating in service learning: Students receive many benefits, including greater self-understanding, self-efficacy, and self-confidence; improved motivation for learning; better communication and leadership skills; and stronger connections and sense of civic duty with the broader community [5, 12, 13, 21, 34, 40, 46]. Students are also exposed to societal issues, communities, and unfamiliar perspectives [10, 12, 14, 38]. Service learning research specific to the CIS discipline has also generated positive findings. A long-term multi-institution study found that students increased in self-efficacy, understanding of the social

relevance of computing, academic performance, and commitment to the major [32]. Service learning has also been shown to be an effective tool in teaching undergraduates about the impact of computing [10, 41]. Several researchers have attempted to use service learning to improve gender ratios in CIS, with positive results [1, 20, 27]. Most scholarship on service learning in CIS, however, takes the form of experience reports, in which faculty share their ideas about course design and lessons learned, only sometimes sharing student feedback and outcomes. Also, few empirical studies have explored CIS students' attitudes toward community engagement when they have not taken (or even heard of) a service learning course, nor have they explored whether community is a motivation in course selection. Empirical research can provide insights about CIS students' attitudes toward service learning and how these relate to sense of civic duty and course-taking motivations. In this paper, we address the following questions:

- What are CIS students' perspectives on service learning when they have or have not taken a course?
- How do CIS students orient to civic duty?
- What are CIS students' motivations for enrolling in courses with respect to personal, civic, or professional goals?
- How do responses vary by demographic groups?

3   Methods

3.1   Survey Design, Analysis, Administration

To answer these questions, we created the CIS Student Service Learning Survey [16]. The survey design was informed by scholarship and Dillman's recommended survey practices [18]. All closed-response questions used a four-point scale with a "don't know" option outside of the scale. Individuals with no service learning experience were asked to comment on what was appealing and unappealing about service learning courses. The survey was piloted with 18 students, whose feedback was incorporated into the final survey. The survey was fielded using Qualtrics, and quantitative results were analyzed using SPSS. Thematic analysis was used to categorize the open-ended data. The anonymous survey was fielded between April-July of 2021.

3.2   Sample Development and Profile

We constructed a list of all U.S. institutions that awarded at least one associate's or bachelor's degree in computer and information science in 2019 using data from the U.S. Department of Education [42]. Research assistants visited websites of each to create a list of faculty email addresses, stratified by type of institution (2-year, Historically Black Colleges and Universities, Hispanic-serving, liberal arts, research, technical, and Tribal colleges). The list was then augmented with authors of CIS-related service learning experience reports. In total, email invitations were sent to 974 faculty members at 491 institutions requesting that they distribute the survey to current or former students, regardless of whether the students had taken a service learning course. No incentive for participation in the survey was offered.

Due to anonymity settings, it is impossible to know the response rate or institutional representation in the final sample,

but respondents likely represent several dozen colleges and universities across the U.S. In total, 227 students provided responses to the survey, and 180 completed the survey in its entirety. Because of an initial problem with software, 31 respondents were not branched to all questions. Another 16 ended the survey before they reached the demographic questions.

Seventy percent of respondents were computer science majors, 14% were computer or electrical engineering majors, and about 16% were in other majors, primarily technically related (e.g., information science, computer information systems, statistics). Respondents ranged from first year to graduate students, including a few who had recently graduated with their bachelor's degree. Among undergraduates, freshmen and seniors made up about half of the sample, with sophomores and juniors making up about 37%. Most students were in the 18-24 age range (91%).

Sixty-nine respondents (38%) identified as women, 99 as men (55%), and 12 (6.7%) as non-binary, preferred not to say, or unsure/questioning; compared to the 2020 U.S. national average of bachelor's degrees awarded (20%), women are overrepresented in our sample. The sample was primarily White at 64%, with 19% Asian, 3% Black, and 6% Hispanic/Latinx. One student was American Indian, one Native Hawaiian, and 12 preferred not to say or selected "other." To support analysis of variance across racial/ethnic groups, racial identity was recoded into a variable to represent "historically overrepresented in computing" (White and Asian; N=149, 83%) and "historically underrepresented in computing" (Black, Hispanic/Latinx, American Indian, and Native Hawaiian; N=19, 11%); 12 (7%) were unknown. Despite our attempt to oversample minority-serving institutions, the proportion of respondents from historically underrepresented racial groups is substantially less than the U.S. national average (25%) of degree conferrals to students from these groups.

4   Results

We asked three banks of questions to understand CIS students' course-taking motivations, sense of civic duty, and perceptions of service learning, the results of which are presented below. Results presented here have varying total response sizes (represented by N in the tables) because of the variation in completing all parts of the survey. We present means (M) and standard deviations (SD) and include sparklines (miniature graphs) to visualize the distributions of responses for each item.

4.1   Motivations for Course Selection

Students responded to seven questions introduced by "How important to you is each of the following when choosing a course?" Response categories ranged from "not at all important" (1) to "very important" (4). A "don't know" option was located outside of the scale. Ordered in Table 1 from highest to lowest average, students considered personal interest in the course (M=3.56), contributing to one's major/minor (M=3.48), and preparation for future occupation (M=3.43) to be moderately to very important. How the course fits in one's schedule was considered moderately important (M=3.18), but student responses were more varied on this item (SD=.96). Applying course concepts to real-world situations was considered moderately important.

In contrast, collaborating with a community and knowing someone else in the course were of much less importance (M=1.69 and 1.67, respectively). Collaborating with community may be of low importance because courses rarely have that feature, as suggested by the number of students who said they have never heard of service learning in our open-ended data. Alternatively, students may perceive that working with a community is charity, not an academically rigorous course, similar to [30]. No differences were observed across demographic groups.

The low importance of knowing someone else in the course was somewhat surprising. It might suggest that students are more concerned with personal interests than interpersonal interaction, or because given the recent move to less personal online classes (resulting from the COVID-19 pandemic), students are not concerned with who else is enrolled when interaction is limited. We found two statistically significant differences across groups on the importance of knowing someone who is planning to take the course. Men (M=1.89, SD=1.00) find it more important that they will know someone than do women (M=1.42, SD=.70) (t(160)=-3.44, p=.001, medium effect size: d=-.52). Similarly, majority students (M=1.74, SD=.91) find it more important than members of underrepresented racial/ethnic groups (M=1.28, SD=.58) that they will know someone in the course (t(28.8)=2.98, p=.006, medium effect size: d=.52). Since women and students of color are often underrepresented in computing courses, they may have a lower expectation of knowing someone, and therefore may be less inclined to consider who else is enrolled.

Table 1 Students' Motivations for Course Selection

Survey Item		N	Mean	SD
The course subject is interesting to me personally.		227	3.56	.60
The course credits contribute to my major or minor.		226	3.48	.77
The course experiences prepare me for my future occupation.		225	3.43	.71
The course time works with my schedule.		226	3.18	.96
The course concepts can be applied to real-world situations.		227	3.17	.84
The course requires collaboration with a community.		214	1.69	.87
I know at least one person who is also planning to take the course.		221	1.67	.88

4-point scale from 1="not at all important" to 4="very important"

4.2   Students' Sense of Civic Duty

Limited Sense of Civic Duty Overall. Students were asked to indicate the frequency with which seven statements were true on a four-point scale ranging from "never true" (1) to "usually true" (4), with a "don't know" option outside of the scale. Table 2 shows that students most often selected "sometimes true" for all items related to civic duty, including wanting to understand others in their community, feeling a personal obligation to help others, wanting to understand others' problems, and believing that social problems are better solved by communities than government. Fewer felt that their future career would involve community partnership (M=2.86, SD=.89). This may represent a lack of knowledge about jobs in the nonprofit or government sectors or

the expectation that these jobs pay less. Even fewer indicated that their families were involved in their communities (M=2.36, SD=1.05). We found no differences on these items between students who are historically over- and underrepresented in computing nor among students who are non-binary or unspecified gender. However, women more often than men wanted to understand others and the problems they face in their community (respectively, women M=3.36 SD=.70, men M=3.14, SD=.96, t(166)=2.823, p=.024, d=.36; women M=3.41, SD=.53, men M=2.98, SD=.80, t(166)=2.281, p=.005, d=.44). The effect size for each of these is between small and medium. Note that the standard deviation for men is relatively large, suggesting strong variation. Results support other studies that suggest women are more interested in social problems and that service learning courses may be useful for retaining women in computing [33].

Table 2 Students' Sense of Civic Duty

Survey Item		N	Mean	SD
I feel that social problems are better solved by community members than by the government.		180	3.38	.63
I feel a personal obligation to help others.		196	3.35	.76
I want to understand the problems that others face within the community.		196	3.27	.75
I want to better understand others in my community.		195	3.15	.85
I can make a difference in the community.		185	3.03	.75
My future career will include some form of community partnership.		145	2.86	.89
My family is involved within the community already.		183	2.36	1.05

4-point scale from 1="never true" to 4="usually true"

We also compared students who had and who had not taken a service learning course on these survey items. Students who had taken a service learning course more often felt it was true that they could make a difference in the community (M=3.32, SD=.70) than students who had not (M=2.97, SD=.75) t(183)=2.445, p=.015. The effect size is medium (d=.48). It is unclear, however, whether students take service learning and then feel they can make a difference or students who more often feel they can make a difference take service learning courses. However, the finding is consistent with other research that has found that after taking a service learning course, students are surprised that they can make knowledge and skill contributions [9, 43]. We were surprised at the frequency of students who felt these statements were never or rarely true, presented in Table 3. Perhaps especially concerning is the large percentage of students who never or rarely feel they can make a difference in the community, considering that they are being trained as professionals in a field that influences nearly every kind of human endeavor today.

Civic Duty Scale. To further explore differences across groups and service learning experiences (Section 4.3), we created a scale variable, the Civic Duty Scale, based on the dimensions represented by the survey items. Omitting "family involvement" due to lower correlation with the remaining six items, the resulting scale had good reliability (α=.76), a mean of 3.2 ("sometimes true") and standard deviation of .52. We then

compared respondents who had or had not taken a service learning course; students who had taken a service learning course (M=3.40, SD=.47) scored higher than students who had not (M=3.17, SD=.53), which was very close to statistical significance (t(131)=1.947, p=.054, small-medium effect size: d=.439). Although we did not find differences among binary, questioning, or prefer-not-to-say genders, we also found a near-significant difference between men (M=3.12) and women (3.31) (t(109)=1.85, p=.07; small effect size: d=.36). We found no statistically significant differences by academic standing or race.

Table 3 Never or Rarely Concerned with Community (N=196)

Survey Item	Never true	Rarely true
I want to better understand others in my community.	5.1%	14.4%
I want to understand the problems that others face within the community.	1.5%	13.3%
I feel a personal obligation to help others.	3.1%	8.2%
I feel that social problems are better solved by community members than by the government.	0.6%	6.1%
I can make a difference in the community.	1.6%	21.6%
My future career will include some form of community partnership.	6.9%	26.2%

4.3 Students' Service Learning Experiences and Attitudes

Twenty-eight students reported that they had taken one or two service learning courses. For 12 of these, the course was required; 14 took the course as elective; and two could not remember if the course was required or elective. We asked these students to rate their level of agreement or disagreement with 18 survey items using a four-point scale ranging from "strongly disagree" (1) to "strongly agree" (4), with a "don't know" option. Survey items and distribution are shown in Table 4. Items are grouped by three categories: personal goals and overall evaluation (top, no shading); professional goals (shaded); and civic engagement (bottom, no shading) and ordered from highest to lowest mean per category. Except for "required versus elected," small group sample sizes prevented us from testing for differences by demographics.

Personal goals and overall evaluation. Students felt positively about having taken the class, as shown by interest in taking more service learning courses, taking the course again, satisfaction with the course, and recommending the course to other students—all had means greater than 3 and relatively small standard deviations. There was no statistically significant difference between students who were required versus elected to take the course.

Professional goals. Substantially more students agreed than disagreed that the course had given them practical experience related to professional goals. Nearly all students agreed that the course combined classroom with practical work/community experience (M=3.22, SD=.89), they learned how to apply course concepts to real situations (M=3.37, SD=.69), had experiences that prepared them for their future jobs (M=3.00, SD=.73), and had experiences that will contribute to career success (M=3.29, SD=.55). However, required-course students expressed much stronger agreement than elective students that the course combined classroom with practical experience (M=3.58; t(24)=2.22, p=.036; large effect: d=.87) and that the course prepared them for

their future occupation (M=3.50; t(23)=3.73, p=.001; very large effect: d=1.49). One possible explanation for this difference is that requiring a course gives it greater credibility and endorsement (e.g., by an accrediting agency like ABET) or that people in authority believe it is a best practice. Alternatively, students in required courses may be explicitly told that the experience is practical and will prepare them for the future as a rationale for being required, whereas when a course is optional, students' own personal interests drive their involvement and their interests do not automatically connect to professionalism.

Table 4 Students' Experiences in and Perception of Service Learning Courses

Survey Item		N	Mean	SD
I was able to make at least one personal connection to the course ideas.		28	3.39	.74
I would recommend the course to other students.		27	3.26	.81
I am satisfied with the course.		27	3.15	.72
I am interested in taking more service-learning courses.		23	3.09	.79
I would take the course again.		27	3.07	.87
I learned how to apply course concepts to real situations.		27	3.37	.69
I had experiences in the course that will contribute to my career success.		24	3.29	.55
The course combined classroom-based education with practical work/community experience.		27	3.22	.89
I had experiences that prepared me for my future occupation.		27	3.00	.73
I completed activities that required direct collaboration with a community partner.		28	3.50	.84
I only interacted with the community partner during the course, but not after.		27	3.30	.78
I have a deeper understanding of people whose backgrounds are different from mine (e.g., culture, race, financial status).		26	3.23	.91
I am more likely to take on leadership roles in my community in the future.		24	2.92	.72
I plan to be more involved in service within the community.		25	2.88	.73
I made connections with others who had passions similar to mine.		27	2.78	.75
I developed a strong relationship with the community partner.		27	2.74	.71
I remained active in the community after the course was done.		27	2.15	.86

4-point scale from 1="disagree strongly" to 4="agree strongly"

Civic Goals. The survey items for civic goals were phrased as experiences and outcomes related to students' interaction and relationships with community partners, and continued and future involvement with community. Most students agreed that they directly collaborated with community partners (M=3.5, SD=.84), which is one of the ways that faculty and professional associations hope to foster altruism and communication skills. Students were less likely to agree that they developed strong relationships with their community partner (M=2.74, SD=.71), or to have made connections to others with passions similar to their own (M=2.78, SD=.75). Most students agreed, however, that they gained a deeper understanding of others whose culture, race, or financial status

were different from their own, though with somewhat more variation (M=3.23, SD=.91). A majority interacted with the community partner only during the course (M=3.3, SD=.78) and most reported that they did not remain active in the community after the course (M=2.15, SD=.86). Still, the experience may have influenced students' attitudes toward civic engagement: more students agreed than disagreed that in the future, they would be more likely to take on community leadership (M=2.92, SD=.72) and be involved in service (M=2.88, SD=.73). We found no statistically significant differences between students who were required versus elected to take the course.

Service Learning Association with Civic Duty. We used the Civic Duty Scale described above to understand the relationships between students' service learning attitudes and outcomes. Using Pearson's correlation, we found that students' sense of civic duty was positively correlated with interest in taking more service learning courses ($r(14)=.70$, $p=.002$), making a personal connection to the course ideas ($r(18)=.69$, $p=.001$), plan to be more involved within the community ($r(18)=.61$, $p=.004$), and a deeper understanding of people of different backgrounds ($r(17)=.47$, $p=.041$). We found no significant difference between required versus elected courses. The number of students this analysis represents is small and the data is cross-sectional, so attributing causal direction is impossible. Still, the data shows a positive relationship between taking a service learning course and increased civic duty, a finding that is consistent with two meta-analyses and a large-scale study [12, 13, 46].

4.4 Perspectives of Students Without Service Learning Experience

Having presented the definition of service learning, we asked respondents if they had taken such a course. Students who had not taken a service learning course were branched to an open-ended text box with a description that read, "You said you have not taken a service learning course. Using our definition, what seems appealing or unappealing about service learning courses?" Respondents offered perspectives about what they found appealing, unappealing, or both. Shown in Table 5, 153 students completed the question: 112 offered responses about what was appealing; 53 about what was unappealing. Thirty respondents provided no response or said that they didn't know, and 16 stated only that service learning was not offered at their university or they were unfamiliar with it.

Of the 73% of respondents who found service learning appealing, most responses centered on contributing to the community while maintaining a balanced and authentic learning situation. The most frequent characteristic of service learning noted as appealing was that service learning provides an authentic learning experience (n=41); for example, one respondent noted, "The knowledge gained through participation in a service-learning course is directly applicable in the real world, which is not always the case with other courses" (Respondent 137). Thirty students noted that service learning is appealing when the student can contribute to the community. Sixteen students cited service learning's ability to help them develop and reinforce skills. For

example, one wrote, "[Service learning] teaches soft skills and not just academic." (Respondent 54).

Table 5 Perceptions of Students Unfamiliar with Service Learning

Theme	N	%
Appealing	**112**	**73%**
Have an authentic learning situation	41	27%
Contribute to the community	30	20%
Develop and reinforce student skills	16	10%
Generally appealing or interesting	13	9%
Appealing under a certain condition	12	8%
Unappealing	**53**	**35%**
Generally unappealing or uninteresting	23	15%
Time consuming	18	12%
Does not contribute to future plans	7	5%
Free labor	5	3%
Other	**46**	**30%**
No response or did not know	30	20%
Not offered in their program or unfamiliar	16	10%

Twelve students wrote that service learning would be appealing, but only under certain conditions—particularly that the course be balanced in both workload and benefit. For example, Respondent 10 wrote, "I worry about performative action and whether service learning tokenizes communities. However, if the relationship is truly mutually beneficial, then I fully support!" Another student wrote:

> Project based courses suffer from a scoping problem. If you leave it up to the students to decide the project, they can quickly come up with something too ambitious. On the other hand, when you leave it up to the course coordinator/lecturer/professor you can run the risk of not properly representing the wealth of opportunities to work with communities that individual students with individual experience might contribute to. (Respondent 102)

Conversely, 35% of respondents reported that service learning was unappealing in some way. Most students did not offer any specific characteristic that was unappealing, just that the service opportunity was generally not appealing (n=23). For example, one student wrote, "[N]o interest in serving others" (Respondent 97). Other respondents offered more specific rationale. Some students (n=18) believe that service learning courses are too time-consuming: "[B]etween my required course-load and COVID-19, it was impractical to pursue this kind of course" (Participant 49). Other students either felt that service learning courses do not line up with their academic or career path (n=7) or that the prospect of working without pay was unappealing (n=5).

5 So... Why Should CIS Programs Require Service Learning?

This study is limited by reliance on a sampling method mediated by instructors; as such, the sample is not completely random, the response rate is unknown, and the sample size is relatively low for certain cross-group comparisons. Nonetheless, it provides evidence and insights on the benefits of service learning for both students and the field. Yet overall, few students in our sample had awareness of, access to, or experience with service learning, even though we often solicited instructor participation based on service learning experience reports. We address here our provocation, arguing that CIS programs should require service learning

experiences, but tempering our argument by suggesting they should only do so if they address serious pitfalls.

5.1 In Order To...

Build a more just and civil society. The study presented here is consistent with other large studies [12, 22, 46] that have found a reciprocal relationship between service learning and civic goals, both in terms of helping students make personal connections to course ideas and in developing a deeper understanding of people from different backgrounds. Our respondents who experienced service learning more often agreed than students with no service learning experience that they had learned about people who were different from themselves and had plans to be more involved in communities. Further, taking service learning courses, whether required or elective, was strongly associated with positive sense of civic duty. As such, service learning can fill an important role in making well-rounded and prepared citizens—an essential mission of higher education. Our findings suggest that students often believe they cannot make a contribution and that they do not understand how service learning contributes to communities. While this may be healthy skepticism, departments requiring service learning can help students understand how to contribute to a more just and civil society.

Improve the relevance of the major and build professional competence. Our results suggest that students select service learning courses because the academic experience is socially relevant and personally meaningful. Students appreciated understanding how technical and soft skills are applicable to real-world situations that can benefit a community. CIS students who find courses to be personally meaningful often adjust their goals and report more positive experiences [26]. Respondents also reported gains in terms of personal goals and professionalism. Those who took a *required* service learning course appreciated the professional outcomes more than students who elected a course.

Attract and retain students. Students who have a high need to make a positive impact on society have been found to be less likely to pursue STEM fields [17]. Having a service learning requirement could be a useful way of attracting students with different life goals or students who are motivated by civic duty when they perceive commitment to community and society is part of the major. In this study, women were shown to care more about others and problems in the community than were men. Students in this and other CIS-based studies have reported that they were not aware of the impact they could have with their degree [7, 46]. In addition, ample research shows that relevant, meaningful curriculum predicts students' retention in the major, especially among groups who are historically underrepresented in computing [2, 3, 23, 28, 37].

Encourage enrollment through department endorsement. When selecting courses, students in this study reported practical considerations: how the course contributes to degree requirements, prepares them for future jobs, and fits with their schedule. But they also prioritized personal interests. Few respondents indicated that they choose courses based on participation of community, but they are largely unaware that it is possible. In this study, service learning was appealing to most students with no service learning experience. However, merely offering service learning courses will not ensure that students take them. Left to their own interests, students might not take data structures, statistics, or team-based project courses either, yet these are required in most CIS programs because the field considers them to be important—and students likely believe the curriculum is designed to serve their professional goals.

5.2 But Only if They Can Address the Pitfalls

Departments can include service experiences in required courses to reap the benefits described above. However, they should only do so if they can address several serious pitfalls.

Courses may fail to include preparation beyond the technical. In our prior research, faculty who incorporated service experiences in their courses reported a wide variety of projects, from website and software development to UX or hardware design to mentoring students and teaching senior citizens. They also reported working with many types of community partners, from schools to nonprofits to health organizations [4]. To assume that students have the non-technical skills to be able to apply the learning objectives of a course across this breadth of social contexts is problematic. Students' ability to understand how their technical solutions might exacerbate problems across these contexts is also questionable [31, 39]. Computer science is criticized for the tacit belief that technical interventions can solve all manner of problems and CIS students are socialized similarly [15]. Effective courses would make students aware of the many "traps" of doing social good [39].

Few resources are available to support faculty. If students are truly expected to develop a sense of civic duty and understand what constitutes a genuine contribution, learning about social and ethical issues such as how to take an insider perspective, fairness, systemic injustice, and hegemony are critical. CIS faculty may have limited background in these issues, much less how to teach them or align them with appropriately scoped projects. Relevant for faculty would be a valuable contribution to the community.

Courses may cause harm to both community partners and to students. Many nonprofit organizations are chronically under-resourced, especially related to technology and technical expertise [6, 45]. Prior research, for example, has documented instances when volunteers built technology for community partners who were unable to maintain or use the technology after the volunteers handed it off [45]. Service projects ask these same organizations to contribute their time, often for projects that do not ultimately provide value [6, 19, 36, 44]; this harm to community partners must be avoided. Relatedly, if projects do not provide value to community partners, it can harm students by engendering false beliefs about their ability to understand or solve complex social problems.

It will be important for CIS programs that require service learning to ensure students learn more than technical skills, effectively supporting faculty in offering courses, and minimizing the potential harms to community partners and to students.

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REFERENCES

[1] Al-khalifa, H. 2010. Overcoming Gender Segregation in Service Learning Projects: A Case from Saudi Arabia. *Proceedings of the 2010 ACM Conference on Information Technology Education* (New York, NY, USA, 2010), 121–124.

[2] Barker, L. et al. 2014. Results of a large-scale, multi-institutional study of undergraduate retention in computing. *Proceedings of the 44th Annual Frontiers in Education Conference* (October 22-25, 2014, Madrid, Spain, 2014), 1693–1700.

[3] Barker, L.J. et al. 2009. Exploring factors that influence computer science introductory course students to persist in the major. *Proceedings of the 40th ACM Technical Symposium on Computer Science Education.* (2009), 153–157. DOI:https://doi.org/10.1145/1508865.1508923.

[4] Barker, L.J. et al. 2021. Service Interruption: Managing Commitment to Community Partners During a Crisis. *ICER 2021: Proceedings of the 17th ACM Conference on International Computing Education Research.* (2021), 11.

[5] Beatty, S.H. et al. 2016. The effects of an alternative spring break program on student development. *Journal of Higher Education Outreach and Engagement.* 20, 3 (2016), 90–119.

[6] Bopp, C. et al. 2017. Disempowered by Data: Nonprofits, Social Enterprises, and the Consequences of Data-Driven Work. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (New York, NY, USA, 2017), 3608–3619.

[7] Bringle, R.G. et al. 2010. The Role of Service-Learning on the Retention of First-Year Students to Second Year. *Michigan Journal of Community Service Learning.* 16, 2 (2010), 38–49.

[8] Brinkman, B. and Diekman, A. 2016. Applying the Communal Goal Congruity Perspective to Enhance Diversity and Inclusion in Undergraduate Computing Degrees. *Proceedings of the 47th ACM Technical Symposium on Computing Science Education* (New York, NY, USA, 2016), 102–107.

[9] Brooks, C.H. 2008. Community connections: lessons learned developing and maintaining a computer science service-learning program. *ACM SIGCSE Bulletin.* 40, 1 (2008), 352–356.

[10] Buckley, M. et al. 2004. Benefits of using socially-relevant projects in computer science and engineering education. *Proceedings of the 35th SIGCSE technical symposium on Computer science education* (Norfolk, Virginia, USA, Mar. 2004), 482–486.

[11] Carter, L. 2011. Ideas for Adding Soft Skills Education to Service Learning and Capstone Courses for Computer Science Students. *Proceedings of the 42Nd ACM Technical Symposium on Computer Science Education* (New York, NY, USA, 2011), 517–522.

[12] Celio, C.I. et al. 2011. A meta-analysis of the impact of service-learning on students. *Journal of Experiential Education.* 34, 2 (2011), 164–181.

[13] Choo, J. 2019. What Works in Service-Learning? Achieving Civic Outcomes, Academic Connection, Career Preparation, and Personal Growth in Students at Ngee Ann Polytechnic. *Michigan Journal of Community Service Learning.* 25, 2 (Sep. 2019). DOI:https://doi.org/10.3998/mjcsloa.3239521.0025.208.

[14] Coelho, M. and Menezes, I. 2021. University Social Responsibility, Service Learning, and Students' Personal, Professional, and Civic Education. *Frontiers in Psychology.* 0, (2021). DOI:https://doi.org/10.3389/fpsyg.2021.617300.

[15] Connolly, R.W. 2012. Is There Service in Computing Service Learning? *Proceedings of the 43rd ACM Technical Symposium on Computer Science Education* (New York, NY, USA, 2012), 337–342.

[16] Designing to Overcome the Asymmetry Problem in Computer and Information Science Service Learning: *https://sites.google.com/colorado.edu/service-learning-in-cis/home.*

[17] Diekman, A.B. et al. 2010. Seeking Congruity Between Goals and Roles: A New Look at Why Women Opt Out of Science, Technology, Engineering, and Mathematics Careers. *Psychological Science.* 21, 8 (Aug. 2010), 1051–1057. DOI:https://doi.org/10.1177/0956797610377342.

[18] Dillman, D.A. et al. 2014. *Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method.* John Wiley & Sons, Incorporated.

[19] Dourish, P. et al. 2020. On Being Iterated: The Affective Demands of Design Participation. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (New York, NY, USA, Apr. 2020), 1–11.

[20] Egan, M.A.L. and Johnson, M. 2010. Service Learning in Introductory Computer Science. *Proceedings of the Fifteenth Annual Conference on Innovation and Technology in Computer Science Education* (New York, NY, USA, 2010), 8–12.

[21] Eyler, J. et al. 2001. At A Glance: What We Know about The Effects of Service-Learning on College Students, Faculty, Institutions and Communities, 1993- 2000: Third Edition. *Higher Education.* (Aug. 2001).

[22] Eyler, J. 2002. Reflection: Linking Service and Learning—Linking Students and Communities. *Journal of Social Issues.* 58, 3 (2002), 517–534. DOI:https://doi.org/10.1111/1540-4560.00274.

[23] Funke, A. et al. 2016. Different Perceptions of Computer Science. *2016 International Conference on Learning and Teaching in Computing and Engineering (LaTICE)* (Mar. 2016), 14–18.

[24] Giannakos, M.N. et al. 2017. Understanding student retention in computer science education: The role of environment, gains, barriers and usefulness. *Education and Information Technologies.* 22, 5 (Sep. 2017), 2365–2382. DOI:https://doi.org/10.1007/s10639-016-9538-1.

[25] Guzdial, M. 2013. Exploring Hypotheses About Media Computation. *Proceedings of the Ninth Annual International ACM Conference on International Computing Education Research* (New York, NY, USA, 2013), 19–26.

[26] Hazley, M.P. et al. 2014. Changes in student goal orientation across the semester in undergraduate computer science courses. *2014 IEEE Frontiers in Education Conference (FIE) Proceedings* (Oct. 2014), 1–7.

[27] Jessup, E.R. et al. 2005. Report from the trenches: Implementing curriculum to promote the participation of women in computer science. *Journal of Women and Minorities in Science and Engineering.* 11, 3 (2005), 273–294.

[28] Khan, N.Z. and Luxton-Reilly, A. 2016. Is computing for social good the solution to closing the gender gap in computer science? *Proceedings of the Australasian Computer Science Week Multiconference* (New York, NY, USA, Feb. 2016), 1–5.

[29] Margolis, J. and Fisher, A. 2002. *Unlocking the clubhouse: Women in computing.* MIT Press.

[30] Mitchell, T.D. 2008. Traditional vs. Critical Service-Learning: Engaging the Literature to Differentiate Two Models. *Michigan Journal of Community Service Learning.* 14, 2 (2008), 50–65.

[31] Pal, J. 2017. CHI4Good or Good4CHI. *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (New York, NY, USA, May 2017), 709–721.

[32] Payton, J. et al. 2016. STARS Computing Corps: Enhancing Engagement of Underrepresented Students and Building Community in Computing. *Computing in Science Engineering.* 18, 3 (May 2016), 44–57. DOI:https://doi.org/10.1109/MCSE.2016.42.

[33] Payton, J. et al. 2015. The effects of integrating service learning into computer science: an inter-institutional longitudinal study. *Computer Science Education.* 25, 3 (Jul. 2015), 311–324. DOI:https://doi.org/10.1080/08993408.2015.1086536.

[34] Pollock, L. et al. 2018. A Computer Science Study Abroad with Service Learning: Design and Reflections. *Proceedings of the 49th ACM Technical Symposium on Computer Science Education* (New York, NY, USA, 2018), 485–490.

[35] Porter, L. and Simon, B. 2013. Retaining Nearly One-third More Majors with a Trio of Instructional Best Practices in CS1. *Proceeding of the 44th ACM Technical Symposium on Computer Science Education* (New York, NY, USA, 2013), 165–170.

[36] Rosmaita, B.J. 2007. Making Service Learning Accessible to Computer Scientists. *Proceedings of the 38th SIGCSE Technical Symposium on Computer Science Education* (New York, NY, USA, 2007), 541–545.

[37] Ryoo, J.J. 2019. Pedagogy that Supports Computer Science for All. *ACM Transactions on Computing Education.* 19, 4 (2019), 1–23. DOI:https://doi.org/10.1145/3322210.

[38] Sanderson, P. and Vollmar, K. 2000. A Primer for Applying Service Learning to Computer Science. *Proceedings of the Thirty-first SIGCSE Technical Symposium on Computer Science Education* (New York, NY, USA, 2000), 222–226.

[39] Selbst, A.D. et al. 2019. Fairness and Abstraction in Sociotechnical Systems. *Proceedings of the Conference on Fairness, Accountability, and Transparency* (New York, NY, USA, Jan. 2019), 59–68.

[40] Sevier, C. et al. What Value Does Service Learning Have on Introductory Engineering Students' Motivation and ABET Program Outcomes? 17.

[41] Tan, J. and Phillips, J. 2005. Incorporating Service Learning into Computer Science Courses. *J. Comput. Sci. Coll.* 20, 4 (Apr. 2005), 57–62.

[42] The Integrated Postsecondary Education Data System (IPEDS): 2019. *https://nces.ed.gov/ipeds/use-the-data.*

[43] Traynor, C. and McKenna, M. 2003. Service Learning Models Connecting Computer Science to the Community. *SIGCSE Bull.* 35, 4 (Dec. 2003), 43–46. DOI:https://doi.org/10.1145/960492.960523.

[44] Voida, A. et al. 2012. Bridging Between Organizations and the Public: Volunteer Coordinators' Uneasy Relationship with Social Computing. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (New York, NY, USA, 2012), 1967–1976.

[45] Voida, A. et al. 2011. Homebrew Databases: Complexities of Everyday Information Management in Nonprofit Organizations. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (New York, NY, USA, 2011), 915–924.

[46] Yorio, P.L. and Feifei Ye 2012. A Meta-Analysis on the Effects of Service-Learning on the Social, Personal, and Cognitive Outcomes of Learning. *Academy of Management Learning & Education.* 11, 1 (Mar. 2012), 9–27.