

9-13-2023

The Impact of Community Engagement on Undergraduate Social Responsibility Attitudes

Daniel S. Schiff

Jeonghyun Lee

Jason Borenstein

Ellen Zegura

Follow this and additional works at: <https://docs.lib.purdue.edu/pspubs>

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries.
Please contact epubs@purdue.edu for additional information.

The Impact of Community Engagement on Undergraduate Social Responsibility Attitudes

Daniel S. Schiff, Department of Political Science, Purdue University, West Lafayette, IN, USA;
ORCID: 0000-0002-4376-7303; Corresponding author: dschiff@purdue.edu

Jeonghyun Lee: Center for 21st Century Universities, Georgia Institute of Technology, Atlanta, GA, USA; ORCID: 0000-0003-1497-0561

Jason Borenstein: School of Public Policy, Georgia Institute of Technology, Atlanta, GA, USA;
ORCID: 0000-0002-1505-4349

Ellen Zegura: School of Computer Science, Georgia Institute of Technology, Atlanta, GA, USA;
ORCID: 0000-0002-4756-1759

July 13, 2023

Abstract

The literature on student development cautions that social responsibility attitudes may stagnate or decline as students proceed through college. Given the importance of students' future professional obligations to society, identifying ways to reverse this trend is crucial. In turn, an important aim of this study, situated at a large public university, is to evaluate the prospects of community engagement as a strategy to foster professional social responsibility development. The study uses longitudinal results from an instrument known as the Generalized Professional Responsibility Assessment (GPRA) to assess personal and professional social responsibility attitudes. The study's sample includes 128 students who completed a survey both in 2017, when entering college, and in 2019, when near the midpoint of college. Findings indicate that social responsibility attitudes remain stagnant, and that students over that time period attach more importance to salary as compared to helping people when considering job priorities. Yet, results reveal that increased community engagement predicts growth in social responsibility attitudes, even when controlling for students' pre-college social responsibility attitudes and demographic characteristics. Further, a novel contribution of this study is a focus on two sub-categories of community engagement: discipline-based and peer-based. Discipline-based community engagement appears to foster professional aspects of social responsibility, while community engagement experiences tied to peer interaction appear to exert greater impacts for non-White students. An observation derived from the study is that community engagement, particularly when it connects to a student's discipline or draws on peer influences, could be an effective strategy to promote social responsibility development.

Keywords: Social responsibility, Community engagement, Undergraduate education, Professional ethics, Longitudinal study

Declarations

Funding details: This material is based upon work supported by the National Science Foundation CCE STEM Program under Grant No. 1635554.

Disclosure statement: The authors have no conflicts of interest to report.

Availability of data and code: Due to concerns related to student privacy and confidentiality, data will not be made openly available.

Geolocation information. Authors are located in West Lafayette, IN, and Atlanta, GA, USA.

Acknowledgments: The authors would like to acknowledge Colin Potts, Wendy Newstetter, Emma Logevall, and Quintin Kreth for their contributions to the broader project of which this study is a part.

Introduction

Academic institutions have multifaceted goals when it comes to educating their students. Among those goals, and arguably a foundational purpose of higher education, is to cultivate within students a genuine concern for the public, especially for those planning to join professions that have direct connections to public safety and well-being. Yet there are reasons to suspect that academic institutions are not fully succeeding in achieving this goal, or even worse, are creating an environment where their students' sense of social responsibility diminishes over time (Cech, 2013; Kifle, 2020). In light of these concerns, our research team has engaged in a multi-year mixed methods effort, taking place at a large public university in the United States, to assess changes in student social responsibility attitudes and to consider what factors influence these attitudes in positive or negative directions.

Importantly, a focus of the project and core topic of this paper is the role of community engagement (CE) activities. Indeed, CE has been examined for quite some time in terms of the potential impact that it may have on students (Meadows & Jarema, 2006; Oakes et al., 2011; Pritchard & Tsang, 2000). Yet, much remains unknown the extent to which CE might shape student personal and professional social responsibility development throughout undergraduate education (Natarajathinam et al., 2021). In turn, this paper assesses the role of CE in student social responsibility development including how specific kinds of CE activities impact undergraduate students. To do so, our research team administered a survey to a cohort of undergraduate students at the beginning and midpoint of their careers at an academic institution, measuring student social responsibility attitudes and frequency of participation in CE activities. An important novelty of the study is a proposed distinction between *discipline-based* CE and *peer-based* CE, underexplored factors in the literature. By *discipline-based*, we mean CE activities that overlap with a student's major or specific career aspirations, such as those involving a student chapter of a professional association. By *peer-based*, we mean CE activities that are engaged in or initiated in part due to a desire to socialize with friends or other peers.

Along these lines and as part of the broader project (Schiff et al., 2021; Kreth et al., 2022, three research questions underpin this paper. First, do student professional social responsibility attitudes change while in college and if so, how? Second, do CE activities (including discipline-based and peer-based) contribute to a change in social responsibility attitudes? Third, how do student characteristics moderate the role of CE in social responsibility development? The findings reported here suggest that CE may contribute to social responsibility development.

The paper is organized as follows. We begin by reviewing the two pillars of our conceptual framework: the literature on social responsibility and the role of CE in its development. We then describe the study context, participants, and measurement and analysis approach. The results section describes patterns regarding social responsibility change and student preferences for salary versus helping others before presenting the findings on the impact of CE. We show how overall CE as well as discipline-based and peer-based CE may impact social responsibility attitudes, and consider whether student demographics moderate impacts. We end with a discussion of study limitations and practical and scholarly observations.

Background and Conceptual Framework

While social responsibility can have different definitions (e.g., Corley, Kim, and Scheufele 2016), it typically refers to one's obligations to act in consideration of the public good. Social responsibility can

apply both to personal and professional contexts. Personal social responsibility describes how individuals may develop an awareness, ability, and a sense of obligation to help others in need in everyday life (Canney & Bielefeldt, 2015a). Yet much of the scholarly discussion on social responsibility pertains to acts performed in one's professional capacity. For example, drawing on the 'safety, health or welfare' phrasing typical in engineering or other professional codes of ethics (ACM 2018; IEEE 1996), Bird (2014) states that "The social responsibility of scientists requires that they also attend to the foreseeable societal impacts of their work, particularly as these impacts affect the safety, health or welfare of the society." Of course, individuals need not be engineers, scientists, or part of a formal profession to have societal responsibilities tied to their job or career.

Given the importance of these dimensions of work, many scholars emphasize the need for students to develop ethical attitudes and skills (Fiesler et al., 2021; Kohlberg, 1984; Rest et al., 2000; Solbrekke & Englund, 2011), including those pertaining to social responsibility. The importance of integrating ethics into the curriculum, including in science and engineering, has been recognized for some time (e.g., National Academy of Engineering 2009). Unfortunately, despite the recognition that social responsibility is an important aspect of educational outcomes, Cech's (2013) research indicates that student social responsibility attitudes remain flat or may even decline over the course of an undergraduate engineering program.

Many strategies have been proposed to cultivate a sense of professional responsibility within students. Prominent among these is classroom-based ethics education (Hess & Fore, 2018), especially the use of standalone ethics courses and ethics case studies in fields such as nursing (Woods, 2005), business (Christensen et al., 2007), and military education (Robinson et al., 2008). Case studies have a long history, for example, in engineering ethics (Fleddermann, 2000; Harris et al., 2019; Herkert, 2000) and bioethics (Pence, 2021). In addition, many scholars contend that 'ethics across the curriculum' is the most likely approach to have a meaningful impact on student professional development (Mitcham & Englehardt, 2019). A relatively new approach to social responsibility education is tying pedagogy to the United Nation's Sustainable Development Goals (Severino-González et al. 2022). There is also an emerging literature on 'University Social Responsibility' that examines how the culture and approaches within academic institutions are tied to social responsibility (e.g., Coelho and Menezes 2021). Further, characteristics of the student population may be tied to social responsibility development, such as gender (Canney & Bielefeldt, 2015b; Lin & Loui, 2017), religion (Canney & Bielefeldt, 2013), and race or ethnicity (Naphan-Kingery et al., 2019).

Another method for cultivating social responsibility is CE, a key focus in our study. While CE can be difficult to define precisely, the *Principles of Community Engagement* (2011) instructively states that CE is "the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people." Along these lines, it is noteworthy that some approaches to CE are broadening their scope beyond local efforts to encompass international and global dimensions of social responsibility (e.g., Jones et al. 2021).

CE is often tied to and encompasses service learning, which is frequently defined as "a teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities" (Ryan, 2012). CE activities do however extend beyond the classroom to include, for example, service-oriented experiences related to student extracurricular groups or professional internships (Rulifson & Bielefeldt, 2018). Thus while CE includes service learning and classroom-oriented activities, the former is broader than the latter and in part

represents a critique of service learning as limited to more transactional, unidirectional engagement (Vanasupa & Schlemmer, 2014; Ward & Wolf-Wendel, 2000).

A primary aim of our study is to examine how CE might shape the personal and especially professional social responsibility attitudes of undergraduate students. To investigate the development of such attitudes, we draw on two conceptual pillars, the first of which is Canney and Bielefeldt's Professional Social Responsibility Development Model (PSRDM), which articulates distinct pathways for personal and professional trajectories (Canney & Bielefeldt, 2015a). The PSRDM has three realms. The first realm is *Personal Social Awareness*, which refers to whether one develops a sense of awareness, self-efficacy, and obligation with respect to helping people in need. The second, *Professional Development*, pertains to whether one gains an appreciation for the ethical and social dimensions of professional activities. In principle, these two distinct realms—Personal Social Awareness and Professional Development—jointly lead to *Professional Connectedness*, or a sense of obligation to help others within the context of one's professional role (Canney & Bielefeldt, 2016). Much is unknown about how personal and professional social responsibility develop jointly or separately. Yet the PSRDM provides a helpful conceptual framework for starting to understand that relationship.

Second, our project's approach and methodology is also informed by the broader CE literature. Studies indicate the effectiveness of CE activities for advancing student outcomes such as interpersonal development, social understanding, commitment to service, and cognitive development (Celio et al., 2011; Eyler et al., 2001; Natarajarathinam et al., 2021), though there are some domains where the impacts are mixed or uncertain. Successful CE may foster sustained involvement (Delve et al., 1990), greater depth of collaboration with communities (Cruz & Giles, 2000; Ward & Wolf-Wendel, 2000), ongoing critical reflection (Eyler, 2002; Mitchell, 2008), and institutional support provided by university leadership (Bender, 2008). Yet only a modest body of evidence shows that CE contributes to the development of key skills and dispositions needed for professional social responsibility in particular to emerge (Astin & Sax, 1998; Bielefeldt & Canney, 2014). Our work aims to address this gap by asking whether CE—or specific forms of CE—can help to bolster social responsibility development.

Methodology

Participants and survey administration

This study is part of a larger research effort and took place at a large public university in the United States. Approximately two-thirds of its undergraduate student population major in an engineering or computing program.¹ The study involved the administration of a survey at two time points to the cohort of undergraduate students who began college in fall 2017. All students in this entering cohort were recruited via email and surveyed approximately one month before entering college, and all enrolled students in the same cohort were surveyed again in the summer of 2019 after they completed their second year of undergraduate studies. 845 students completed the first round of the survey out of 2995 who received a request to participate, while 216 students completed the second round of the survey out of 2437 invited students. To improve response rates, participants in 2019 were offered a \$5 incentive to complete the survey,

¹ Of note, despite growing interest in CE at our institution, it does not have a Carnegie Elective Community Engagement classification.

while participants in 2017 were not compensated. The study was reviewed and approved by the university's Institutional Review Board.

A total of 128 students completed both surveys and passed the attention check questions. Given our emphasis on longitudinal study of student development, these students constitute the analytical sample for the paper. Table 1 displays demographic details of these students along with summary statistics regarding key dependent and independent variables. Given the limited response rates and possibility of differential dropout, we performed checks to assess possible bias related to sample attrition and find no immediate cause for concern. Appendix A provides further details about our study procedures, participants, generalizability of our sample, and tests of sampling bias.

Table 1. Descriptive summary of key variables ($n = 128$ respondents)

Variable	Mean (Std. Dev.)	Range	Variable	Mean (Std. Dev.)	Binary Coding Value
Dependent Variables			Control Variables (continued)		
Personal Social Awareness 2019	6.05 (.65)	[4.23-7.00]	Gender		
Professional Development 2019	6.34 (.63)	[2.33-7.00]	<i>Male</i>	.53 (.50)	[1]
Professional Connectedness 2019	5.47 (.86)	[3.07-7.00]	<i>Female</i>	.47 (.50)	[0]
PSRDM 2019	5.95 (.59)	[4.26-6.98]	Race/Ethnicity		
			<i>White</i>	.55 (.50)	[1]
			<i>Non-White</i>	.45 (.50)	[0]
			College		
Independent Variables			<i>Engineering</i>	.62 (.49)	[1]
Overall CE	53.52 (65.26)	[0-423]	<i>Non-Engineering</i>	.38 (.49)	[0]
Discipline-based CE	21.52 (31.50)	[0-150]	Country of Origin		
Peer-based CE	11.16 (15.94)	[0-70]	<i>USA</i>	.94 (.24)	[1]
			<i>International</i>	.06 (.24)	[0]
			First Generation		
Control Variables			<i>Yes</i>	.03 (.18)	[1]
Personal Social Awareness 2017	6.08 (.65)	[4.22-7.00]	<i>No</i>	.97 (.18)	[0]
Professional Development 2017	6.34 (.64)	[2.89-7.00]	Religious		
Professional Connectedness 2017	5.52 (.88)	[3.31-7.00]	<i>Yes</i>	.52 (.50)	[1]
PSRDM 2017	5.99 (.57)	[4.56-7.00]	<i>No</i>	.48 (.50)	[0]

Note. PSRDM refers to the Professional Social Responsibility Development Model.

Measures and analysis approach

To shed light on the relationship between CE activities and student social responsibility attitudes, we collected longitudinal data using the Generalized Professional Responsibility Assessment (GPRA). The GPRA is adapted from the Engineering Professional Responsibility Assessment (EPRA), a validated instrument based on the PSRDM framework (Canney & Bielefeldt, 2015a, 2016). While the EPRA has engineering students as its target population, our tool was modified to be relevant to students from any discipline. Our key dependent variables are measures of the three overarching realms of the PSRDM. There

are a total of eight constructs based on 42 associated 7-point Likert questions (reproduced in Appendix F) under the three realms of *Personal Social Awareness* (constructs: Awareness, Ability, Connectedness); *Professional Development* (constructs: Base Skills, Professional Ability, and Analysis); and *Professional Connectedness* (constructs: Professional Connectedness and Costs/Benefits). For our key analyses, we aggregate these eight constructs to the level of the three realms by taking averages, and then take a master average-of-averages to establish a single social responsibility score.

While the GPRA is adapted from a validated instrument, we also performed basic reliability testing and made minor refinements, discussed in more detail in Appendix B. Most constructs had acceptable reliability levels as measured by Cronbach’s alpha after we removed two questions from the Analyze construct and one from the Professional Ability construct. However, the Professional Development realm should be interpreted more cautiously given relatively lower reliability scores, as presented in Table 2.

Table 2. Construct and realm reliability scores for PSRDM instrument

PSRDM realm	Construct	Number of items	Cronbach’s alpha
Personal Social Awareness (PSA)	1. Awareness (aw)	5	0.65
	2. Ability (ab)	4	0.75
	3. Connectedness (co)	4	0.80
	<i>PSA realm overall</i>	13	0.77
Professional Development (PD)	1. Base Skills (ba)	1	—
	2. Analyze (an)	2	0.62
	3. Professional Ability (pa)	3	0.47
	<i>PD realm overall</i>	6	0.51
Professional Connectedness (PROC)	1. Professional Connectedness (pc)	19	0.92
	2. Costs-Benefits (cb)	4	0.78
	<i>PROC realm overall</i>	23	0.86

As independent variables, we construct an index measuring overall community engagement during college (*overall CE*) from student responses to a set of questions about the frequency of participation in various CE activities. For example, students were asked how often they engaged in community service through organizations such as Habitat for Humanity, through campus religious organizations, and so on.² Consistent with Bielefeldt and Canney (2016), we apply a simple scaling factor to each activity, such that ‘have not participated’ is multiplied by 0, ‘only a few times during college’ by 1, ‘once or twice per year’ by 2, ‘more than twice a year but not routinely’ by 5, ‘monthly’ by 20, and ‘weekly’ by 50. We aggregate the scaled scores for all CE activities to create the composite score of overall CE. Notably, this score reflects the *quantity* of CE, rather than its *quality*, a limitation and trade-off related to our broad study design.

Additionally, to expand on the scholarly understanding of the impacts of specific types of CE on students, we introduce two novel measures of CE: *discipline-based CE* and *peer-based CE*. Our study’s conceptualization emphasizes the role of discipline-based CE, measured by a subset of CE activities connected with a student’s discipline and profession, in shaping professional social responsibility attitudes. The second novel measure we employ is peer-based CE, which involves activities where peer groups play a major influence in the student’s motivation to participate (e.g., Greek life or other student extracurricular

² These CE activities are overwhelmingly voluntary in the context of the institution. While some students are required to take an ethics course tied to their major, those courses do not usually involve service learning or CE.

organizations). Our interest in this latter measure emanates from our qualitative findings (Schiff et al., 2021) that students often participate in CE activities due to peer influences, including as a way to socialize with friends, and that peers are a major factor in shaping a student’s social responsibility attitudes. We conceive of these two constructs as part of a formative measure approach (Jarvis, BacKenzie, & Podsakoff, 2003) and scale and aggregate responses for each associated subset of CE activities, as with the overall CE measure. Appendix C lists the respective survey items for these two novel measures and discusses our rationale behind the construction of these CE measures and our formative measurement approach.

We use a set of demographic covariates across our models: gender, race/ethnicity, academic major, country of origin, first-generation status, and religiosity. The covariates are aggregated into binary measures (e.g., White vs. non-White, male or female) for both pragmatic and theoretical reasons. Pragmatically, limited sample sizes for certain subgroups preclude a more fine-grained and reliable analysis. Theoretically, research suggests that some subgroups of students have different relationships with CE and social responsibility development that are worth modelling and exploring. For example, Naphan-Kingery et al. (2019) argue that non-White students and women may be influenced by an equity ethic; correspondingly, reporting on possible trends aggregated in this way could help to explain the impact of CE for these important subgroups. The key dependent variables, independent variables, and covariates that constitute our main models are summarized in Figure 1, with additional detail about the sample and construction of variables presented in Appendix A.

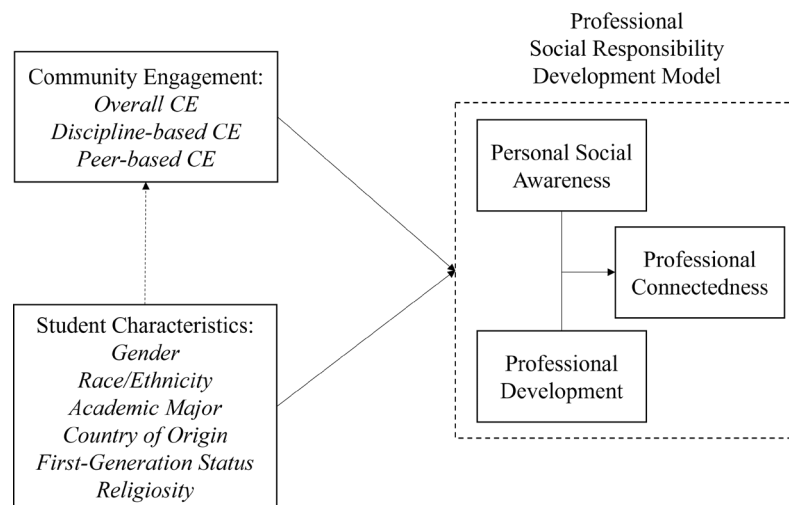


Figure 1. Overview of core study elements and methodological approach. Professional Social Responsibility Development Model (PSRDM) adapted from Canney & Bielefeldt (2015a).

Our primary analysis approach is Ordinary Least Squares (OLS) regression. While related studies assessing the impacts of CE on social responsibility development have identified univariate mean differences in student attitudes over time, this study additionally controls for student characteristics as well as pre-college social responsibility attitudes. This multivariate and longitudinal approach improves our ability to assess causal impacts of CE as compared to cross-sectional or univariate mean comparison approaches alone. Importantly, however, our approach remains limited in terms of both causal robustness and generalizability; we discuss various benefits and limitations of our analysis approach in Appendix D. Finally, we present bivariate correlation coefficients and difference-of-means tests to examine the strength and direction of the relationships among demographic characteristics, CE activities, and PSRDM scores (see Appendix E).

Results

Overall changes in social responsibility attitudes

In line with our first research question, Figure 2 shows changes in overall PSRDM and realm subscores between the two survey administrations, at the beginning and midpoint of the students' undergraduate program. Consistent with Bielefeldt and Canney (2016), Cech (2013), and Howland et al. (2022), we observed little change in overall student social responsibility attitudes over the first half of their undergraduate program. Participants, on average, showed slight and insignificant (Wilcoxon signed-rank test, $p > .05$) decreases from 2017 to 2019 along the Personal Social Awareness (PSA) and Professional Connectedness (PROC) realms, as well as in the (average-of-averages) PSRDM score, and with no detectable change in the Professional Development (PD) realm.³ *These results reiterate concerns that social responsibility attitudes may remain flat or decline during undergraduate education, at least during the first two years of college.*

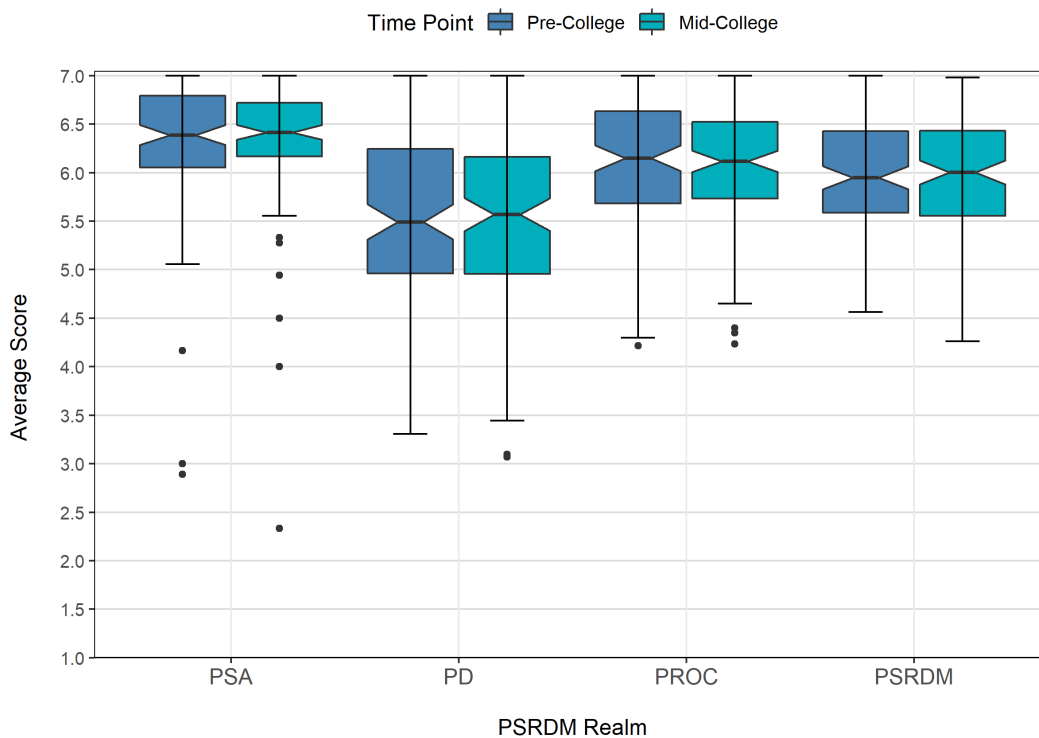


Figure 2. A box-whisker plot of overall changes in PSRDM realms and overall PSRDM scores between 2017 (Pre-College) and 2019 (Mid-College). 5 = ‘Slightly Agree’ and 7 = ‘Strongly Agree.’ ($n = 128$ respondents).

³ While these results present an aggregate picture, Appendix E and Appendix Tables E1 and E2 provides more detail on the number of students who increased or decreased with respect to all PSRDM realms and individual constructs, and whether over-time changes per construct were statistically significant. Based on results from Wilcoxon signed-rank tests comparing pre-college and midpoint SR scores, there were significant changes for the Ability and Base Skills constructs.

Since these responses refer to attitudes that students hold while still in college, it is challenging to extrapolate how they may affect eventual behavior in the workplace. However, the survey instrument includes additional questions that allow examination of values related to one’s anticipated career. In particular, participants were asked to identify which factors are most important to them when seeking a future job, and did so by distributing ten ‘stones’ amongst eight job priority ‘bins,’ including salary, job location, being self-employed, and so on. The score for each job priority thus ranges from 0 to 10 possible points, summing to 10 points across the eight job priorities.

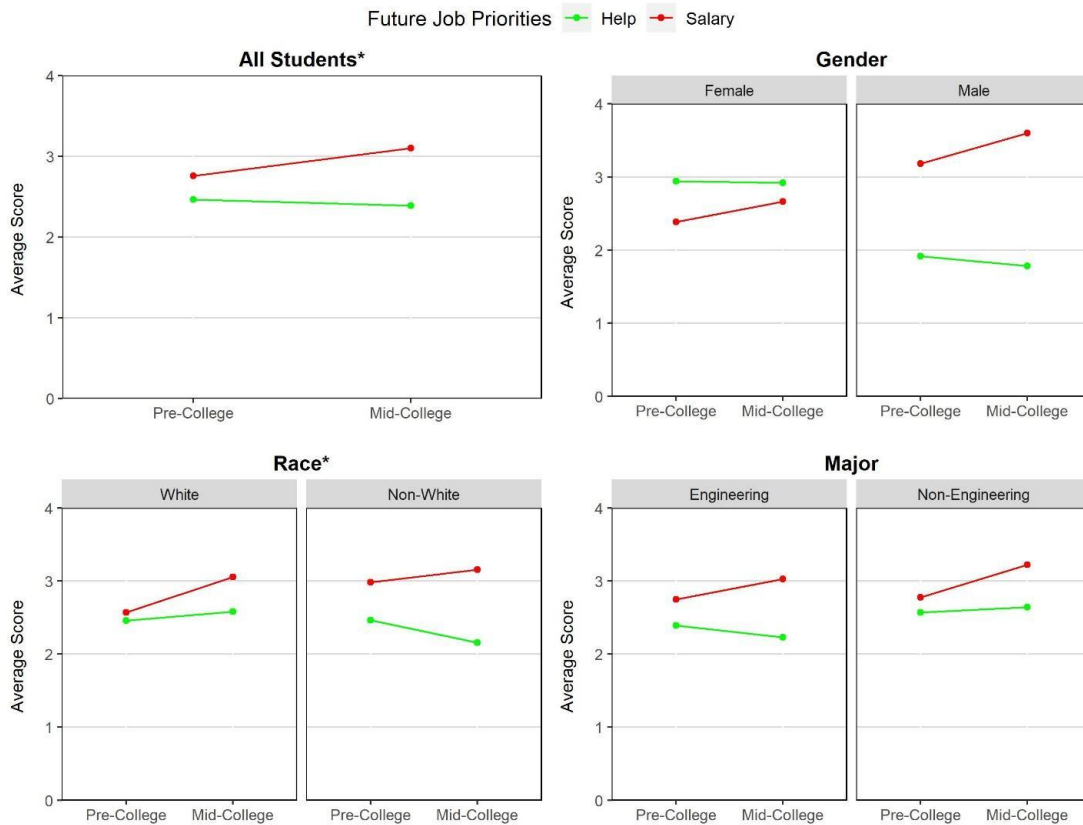


Figure 3. The importance of future job qualities for students: Salary and Helping People ($n = 128$ respondents). Students distributed 10 stones in 8 bins, so the possible range for any given bin (e.g., Salary) is 0-10. Standard deviations are omitted and the range is shortened for visibility. There are statistically significant increases (paired samples t test, $p < .05$) in the importance of Salary for all students and for White students.

Figure 3 examines the priority students placed on two of the job priorities: *Salary* and *Helping People*. We selected these two items because the latter could serve as a rough proxy for social responsibility attitudes and a comparison between them could provide some insight about a student’s career mindset. We compared the average scores for these categories across the two survey time points for the overall participant group and for several demographic subgroups (gender, race/ethnicity, and major). Salary is a clear priority for nearly all subgroups of students other than for female students. *Moreover, for students overall, salary becomes a more critical consideration over time*—with scores increasing from pre-college ($M = 2.76$) to mid-college ($M = 3.10$), paired samples $t(127) = 2.45, p < .05$, whereas the importance of

helping others through one's work remains relatively flat or even declines. These results reinforce the notion that the importance attributed to professional social responsibility, including how it influences career choices, may decline during college.

Impact of overall community engagement on student social responsibility attitudes

We perform OLS multiple regression analysis to identify whether CE might impact student social responsibility attitudes. Our general model specification is: $y = \alpha + \beta CE + \gamma X + \epsilon$, where β corresponds to the association between the CE and PSRDM outcomes of interest (y) and X refers to a vector of student demographic covariates (gender, race/ethnicity, major, country of origin, first-generation status, and religiosity). In some models, we incorporate 2017 PSRDM scores, which help us to control for student pre-college social responsibility attitudes and thus better isolate changes during college.

Three models predicting student 2019 PSRDM scores were tested: Model 1 includes demographic covariates only and reveals that gender has a large association with social responsibility attitudes, while race/ethnicity, student major, international and first-generation status, and religion do not. Model 2 adds the overall college CE index score as a variable (Overall CE 2019); and Model 3 further incorporates each student's pre-college social responsibility attitudes as measured by their overall PSRDM score in 2017. The goodness-of-fit for the models, indicated by R^2 values, improves from Model 1 to Model 3 with Model 3 explaining a sizable 57% of variability of the data. For comparability, we report standardized effects.

As shown in Table 3, the results from Model 2 indicate that a one standard deviation (SD) increase in the degree of overall CE during college was associated with an average .26 SD increase in student PSRDM 2019 scores, holding all covariates constant. In line with the results of our t tests, being a male student is associated with lower social responsibility attitudes, even after controlling for other student characteristics. Additionally, student PSRDM scores are positively predicted by formal religious affiliation in this model. Yet, once pre-college attitudes are controlled for in Model 3, arguably the most robust model, these covariates are no longer significant predictors of PSRDM scores.

Notably, the only statistically significant predictors in Model 3, the only model which takes longitudinal trends into account, are pre-college social responsibility attitudes (PSRDM 2017) and overall CE. Critically to our research questions, *the positive influence of overall CE on PSRDM scores remains statistically significant even when accounting for pre-college PSRDM scores.* In particular, a one SD increase in overall CE during college corresponds to an average .14 SD increase in student PSRDM scores. This finding constitutes promising evidence regarding CE's capacity to foster professional social responsibility attitudes.

Table 3. Results of multiple regression analysis predicting PSRDM 2019 scores: Overall CE

Variable	Model 1			Model 2			Model 3		
	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β	<i>B</i>	<i>SE B</i>	β
Overall CE 2019	-	-	-	.002	.001	.259**	.001	.001	.136*
PSRDM 2017	-	-	-	-	-	-	.626	.071	.609***
Male	-.448	.097	-.378***	-.379	.096	-.320***	-.124	.080	-.106
White	.160	.098	.134	.133	.095	.112	.097	.073	.082
Engineering Major	-.032	.101	-.026	-.024	.097	-.020	-.024	.075	-.020
Country of Origin: USA	.295	.204	.121	.274	.196	.112	.290	.151	.119

First Generation	.066	.283	.020	.120	.273	.035	.203	.210	.060
Religious	.185	.098	.156	.200	.095	.169*	.099	.073	.084
(Constant)	5.697	.212	-	5.558	.209	-	1.831	.457	
R^2	.211			.274			.568		
$RMSE$.540			.521			.400		
F	5.403***			6.454***			19.570***		

Note. * indicates $p < .05$, ** $p < .01$, and *** $p < .001$.

Impact of discipline-based and peer-based community engagement on social responsibility attitudes

We next test the extent to which discipline-based CE (e.g., activities associated with a student's major, internships, and professional organizations) and peer-based CE (e.g., activities where socializing with peers plays a major influence, such as Greek life) predict student social responsibility attitudes, and whether they operate in similar or different ways as compared to overall CE, the more general measure. We again use multiple linear regression and adapt the most robust model from above by varying the key independent variable, while controlling for student covariates and pre-college social responsibility attitudes. Table 4 reports the results for the models which assess the impacts of discipline-based CE (Model 1) and peer-based CE (Model 2) on social responsibility attitudes.

Unlike overall CE and in contrast to our expectations, discipline-based CE does not appear to have statistically significant impacts on overall student PSRDM scores. In contrast, peer-based CE is a statistically significant and positive predictor of overall PSRDM scores while holding all other variables constant. A one *SD* increase in peer-based CE corresponds to a .14 *SD* average increase in PSRDM, similar to the effect size for overall CE. *This result implies that peers or social groups may indeed be influential in enhancing college students' social responsibility attitudes.*

Table 4. Results of multiple regression analysis predicting PSRDM 2019 scores: Discipline-based and Peer-based CE

Variable	Model 1			Model 2		
	B	$SE B$	β	B	$SE B$	β
Discipline-based CE 2019	.002	.001	.103	-	-	-
Peer-based CE 2019	-	-	-	.005	.005	.137*
PSRDM 2017	.628	.073	.610***	.659	.069	.641***
Male	-.134	.080	-.114	-.130	.080	-.110
White	.095	.074	.081	.113	.073	.095
Engineering Major	-.024	.076	-.020	-.026	.075	-.022
Country of Origin: USA	.309	.152	.127*	.301	.151	.124*
First Generation	.176	.212	.052	.195	.210	.058
Religious	.107	.075	.091	.067	.074	.057
(Constant)	1.830	.464	-	1.645	.452	-
R^2	.561			.570		
$RMSE$.404			.399		
F	18.979***			19.724***		

Note. * indicates $p < .05$, ** $p < .01$, and *** $p < .001$. ($n = 128$ respondents)

Notably, however, discipline-based CE positively predicts the Professional Development (PD) realm within the broader PSRDM framework. As the second panel of Figure 4 depicts, there is a positive and substantial predictive relationship between discipline-based CE and PD ($\beta = .20, p < .05$), even when controlling for student covariates and pre-college PD scores, whereas peer-based CE has no such effect on PD scores.⁴ This suggests that students are more likely to gain useful skills and knowledge for their professional growth when engaging in CE activities closely related to their discipline or future profession. *In other words, discipline-based CE could be a key aspect of developing more robust professional social responsibility attitudes.* Yet, discipline-based CE does not appear to bridge the personal and professional trajectories of social responsibility development. A disconnect remains, possibly related to a bifurcation between student personal and professional attitudes, a trend also identified in our prior qualitative work (Schiff et al. 2021).



Figure 4. Coefficient plots for estimating the effect of different types of CE on social responsibility attitudes. The lines indicate 95% confidence intervals; variables whose intervals cross the reference line at 0 are not statistically significant. Overall CE and peer-based CE (but not discipline-based CE) predict PSRDM scores, while overall CE and discipline-based CE (but not peer-based CE) predict PD scores.

⁴ See Appendix F for more detailed information about impacts of the CE measures on all realms of the PSRDM. We find that no CE measure is associated with increased PSA or PROC, and thus focus on PD and PSRDM here.

The role of student demographic characteristics in social responsibility development

Finally, we evaluate how the impact of CE on social responsibility might vary across demographic subgroups, as well as how demographic characteristics might play a role in CE engagement and social responsibility development more generally. Most prominently, female students reported higher CE both before and during college as well as higher levels of social responsibility attitudes. Our findings are consistent with research by Canney and Bielefeldt (2015b) and a body of research indicating higher levels of baseline concern about social issues among female students. Yet despite higher *baseline* attitudes (see Appendix E), female student social responsibility attitudes remain flat over time, and no significant differentiation was detected between genders *over time* in PSRDM scores (i.e., from 2017 to 2019). Moreover, there was no gender-specific impact of CE on their social responsibility attitudes. *That is, females appear to be on a higher but parallel track as compared to male students.* Consequently, one should not assume female students are exempt from the need to foster social responsibility development.

For other demographic characteristics, including international status, major, first-generation status, and religiosity, we observe similar dynamics. In general, there are few notable impacts of CE on social responsibility that are differentiated within a given subgroup. That is, while some subgroups have higher *baseline* social responsibility attitudes and are more likely to participate in CE (e.g., female, non-engineering, American-born, first-generation, and more religious students), *students of all subgroups face flat or declining social responsibility attitudes. Moreover, no student subgroup among those we studied showed statistically significant increases in overall PSRDM scores.*

For race/ethnicity, while subgroups have statistically similar levels of CE participation, peer-based CE has differentially positive impacts on social responsibility attitudes for non-White students as compared to White students. In particular, we tested whether race/ethnicity moderates the relationship between peer-based CE and PSRDM by adding an interaction term between race/ethnicity and peer-based CE to our regression model. As the first panel of Figure 5 depicts, *non-White students who participated in higher levels of peer-based CE had statistically significant increases in social responsibility attitudes compared to White students ($p = .02$).* In contrast, peer-based CE does not produce statistically significant differential impacts by, for example, gender, major, or religion. No other forms of CE were found to produce meaningfully different impacts on social responsibility for other student subgroups

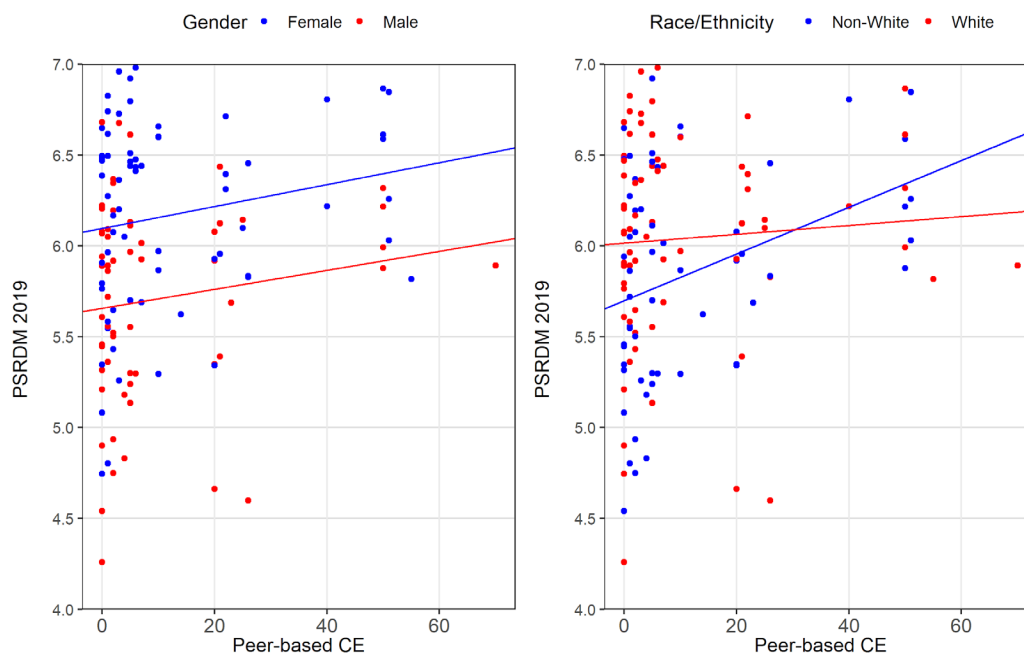


Figure 5. Moderation analysis for student demographic subgroups. Slope lines indicate how peer-based CE predicts PSRDM scores. The x-axis is the scaled measure of student participation in peer-based CE. A statistically significant moderation effect is found for race/ethnicity and peer-based CE ($p = .02$), suggesting peer-based CE has uniquely positive effects on non-White students. Discipline-based and overall CE do not produce significant moderation effects for any subgroup.

It is important to note that the effects of peer-based CE could depend on how peer-based CE is defined (i.e., which kinds of CE ‘count’), the quality of the CE experiences in terms of established best practices, and how demographic groups are coded (e.g., whether race is defined in a binary way or in more finely grained terms). Moreover, we find that CE experiences generally do not lead to differential impacts within and across most student subgroups, which suggests that the experiences and attitudes of students related to CE and social responsibility development may be significantly shaped by common factors such as institutional climate. Nevertheless, peer-based CE could be helpful in supporting social responsibility development for students from minority racial or ethnic groups. More research is needed, however, to understand the possible effects of peer-based CE.

Discussion

This study evaluates whether and how student social responsibility attitudes change over time, and what role community engagement has in fostering student moral development. Our research contributes to the scholarly literature on CE and social responsibility development in several ways.

First, using a survey instrument based on the PSRDM framework, *we provide evidence that CE can indeed promote social responsibility development, even when accounting for student pre-college social responsibility attitudes.* Compared to studies employing cross-sectional or univariate mean differences, our study uses a longitudinal multivariate regression approach (results in Table 3) to provide more robustness as to possible causal effects. While this study lends support to the notion that student social responsibility

attitudes remain flat or decline over time (Howland et al., 2022), it also indicates that CE may constitute an important factor to mitigate or reverse these trends.

Second, our study adds depth to and broadens the scholarly conceptualization of CE. While much of the literature focuses on traditional ‘volunteering’ activities like helping at a food kitchen or donating blood (Bielefeldt & Canney, 2014), our study incorporates a wide variety of CE activities, such as through coursework, internships, and peer groups (see Appendix C). This recognizes that student social responsibility development is not merely a result of a single ethics course, case study, or ‘weekend’ volunteer experience. Rather, it is connected to many different types of experiences that constitute a continuum in an individual’s life. Given our goal of exploring CE in a fuller sense, we examine two novel forms of CE, peer and discipline-based, that the theoretical underpinnings of our approach and our prior qualitative work suggest could be important to student moral development.

Our results indicate that discipline-based CE, activities connected to a student’s major or career aspirations, may shape the Professional Development realm within the PSRDM framework. Yet discipline-based CE fails to drive overall social responsibility attitudes, as depicted in Figure 4 and Appendix F. The underlying explanation for this mixed finding is unclear, though our prior qualitative research suggests that student personal and professional social responsibility attitudes may be disconnected for a variety of reasons. In particular, students typically pursue their majors due to intellectual interest and fit rather than for social or ethical goals; thus, they might not connect their personal values and interests, such as those pertaining to student mental health or racial equity, with professional social responsibility concerns, including obligations to clients or coworkers (Schiff et al. 2021). While discipline-based CE may inform a student’s sense of how their professional development intersects with social or ethical concerns, it may be insufficient to drive a holistic sense of professional connectedness as conceived of in the PSRDM framework. Recent work on CE suggests that further research on factors like logistical and cultural barriers (Natarajarathinam et al., 2021) could help explain why some forms of CE are more effective than others.

In contrast, peer-based CE activities do appear to drive increases in overall student social responsibility attitudes. That peer-based CE does not have an impact on the professional development component suggests that discipline-based CE and peer-based CE act in different ways. Peer-based CE also has a differentially positive impact for students from minority racial or ethnic groups, as depicted in Figure 5. This is in itself worthy of further study. Though some of the CE literature notes the importance of developing genuine and lasting relationships while engaging with members of the community (Eyler, 2002; Ward & Wolf-Wendel, 2000), our findings encourage attention to the dynamics of student social groups as possible drivers of CE engagement and social responsibility development. Fostering these patterns could involve encouraging group activities, peer reflection, or bringing in recent alumni to speak about professional experiences.

Finally, our results illustrate the role of student demographic characteristics in CE and social responsibility development. While certain subgroups, such as female students, may have higher baseline attitudes towards social responsibility (see Appendix E), we find that a variety of student characteristics cease to be statistically significant predictors of social responsibility development once pre-college social attitudes are taken into account. Many student subgroups seem to experience similar patterns of flat or declining social responsibility attitudes in college, even if baseline trends differ. The lone exception in our study cohort is the finding that peer-based CE may be especially helpful in driving social responsibility development for non-White students. Overall, this suggests that common features of student experience in college are driving these trends. Yet targeted strategies and associated research may still be needed to mitigate against social responsibility decline for particular student subgroups (Bielefeldt, 2021).

Limitations

Our study is subject to a number of limitations, some of which we elaborate on in Appendix D. First, while not unusual for student surveys, our response rates are relatively low for both survey administrations (approximately 28% for the 2017 survey and 9% for the 2019 survey). The ultimate study sample that is the focus of this paper—the members of the entering 2017 cohort who completed both studies—constitutes only approximately 5% of the entering 2017 cohort. Relatedly, sample attrition and selection bias could pose a threat to the validity of our results. Yet our statistical tests using logistic regression to predict non-random sampling between the two survey waves (see Appendix A) provide little evidence of sample attrition bias along nearly all observed student characteristics including pre-college social responsibility attitudes and CE activity, though we cannot rule out such bias along unobserved student characteristics. The generalizability to other student populations is also a limitation for reasons unrelated to response rate or attrition, as the student cohort in our study may be dissimilar from other groups of students, for example given the high proportion of engineering majors at the university.

Because our sample size is relatively modest overall, we perform calculations to determine if we are sufficiently powered to detect our main results using the G*Power software tool. A statistical test of ‘Linear multiple regression: Fixed model, R^2 increase’ within the F tests family indicated that a required sample size for a single coefficient is 127 to detect an R^2 increase. This is based on a power level of .80, alpha level of 5%, with 7 predictors, and an effect size of 0.063, corresponding to the R^2 increase between Model 1 and Model 2 in Table 3 (the effect of Overall CE on mid-college PSRDM scores). This suggests our sample size is just large enough to detect the main effects; however, additional analyses that rely on subgroups (e.g., gender or race differences) would require a larger sample size.

Another possible limitation is that the students in the sample had only just completed their second year of their undergraduate program. Other studies have also evaluated students at the midpoint of their academic careers (Bielefeldt & Canney, 2014). Yet students may develop further as they complete their academic programs, participate in internships (Rulifson & Bielefeldt, 2018), and so on. Indeed, it is common at our institution that students take courses more directly connected to their major, such as design or capstone courses, *after the second year* of their degree program. Nevertheless, the experiences and scaffolding during the early years of a student’s academic career are subjects worthy of study.

Other limitations may result from how we approach conceptualization and measurement. For example, the measures of discipline-based and peer-based CE are novel to this study, and could be defined in alternative ways, such as by including other sets of activities in these constructs. The approach to scaling and weighting activities according to the frequency of CE activity participation could be different as well, though our method was designed to be consistent with research in the field such as Bielefeldt and Canney (2014). Additionally, our instrument relies on the psychometric validation performed on the original instrument ours is adapted from Canney and Bielefeldt (2016).

Finally, a key limitation relates to our study’s focus on ‘quantity’ over ‘quality,’ focusing strictly on intensity of CE participation. The literature has established that certain characteristics of CE are especially effective, such as activities that are sustained, collaborative, and involve reflection (Celio et al., 2011; Eyler et al., 2001; Natarajathinam et al., 2021). Yet, given our desire to study the comprehensive range of student CE experiences over time, asking students to accurately recollect additional, specific details of these diverse experiences is prohibitively difficult. This would likely be more feasible in more targeted research focused on a single intervention, for example. As such, while our study allows us to identify the quantity and type of certain CE experiences, it is limited in its ability to explain aspects of

quality like reflection, relationships with community members, or learning goals like civic responsibility. However, our prior qualitative findings suggest that at least some CE experiences students engage in might not adhere to best practice characteristics (Schiff et al. 2021), implying the effects here may represent a lower-bound estimate.

Conclusion

Community engagement appears to serve as a viable strategy for fostering social responsibility development for undergraduate students. This could be of interest for educators attending to student social responsibility development, as well as employers looking to cultivate a sense of professional social responsibility at the workplace. This study highlights two specific and potentially important sub-types of CE—discipline-based and peer-based—that may contribute to student moral development. However, more work is needed to understand how these and other types of CE activities influence social responsibility attitudes. Future research should seek to examine the effectiveness of specific features of CE activities, how CE interacts with both personal and professional dimensions of social responsibility, and how the continuum of CE experiences shape social responsibility attitudes alongside other influences and inhibitors in students' lives.

References

- Association for Computing Machinery US Public Policy Council. (2018). *ACM Code of Ethics and Professional Conduct*. Association for Computing Machinery.
- Astin, A. W., & Sax, L. (1998). How Undergraduates Are Affected by Service Participation. *Journal of College Student Development*, 39, 251.
- Bender, G. (2008). Exploring conceptual models for community engagement at Higher Education Institutions in South Africa: Conversation. *Perspectives in Education*, 26(1), 81–95.
- Bielefeldt, A. R., & Canney, N. (2014). Impacts of service-learning on the professional social responsibility attitudes of engineering students. *International Journal for Service Learning in Engineering*, 9(2), 47.
- Bielefeldt, A. R. (2021, July 26). *Intersectional Complexities of Race/Ethnicity and Gender in Engineering Students' Professional Social Responsibility Attitudes (Research)*. 2021 ASEE Virtual Annual Conference & Exposition. <https://peer.asee.org/intersectional-complexities-of-race-ethnicity-and-gender-in-engineering-students-professional-social-responsibility-attitudes-research>
- Bird, S. J. (2014, July 3). Social Responsibility and Research Ethics: Not Either/Or but Both. *American Association for the Advancement of Science*. <https://www.aaas.org/news/social-responsibility-and-research-ethics-not-eitheror-both>
- Canney, N. E., & Bielefeldt, A. R. (2013). Examining the correlation between religion and social responsibility in engineering. *2013 IEEE Frontiers in Education Conference (FIE)*, 1819–1824. <https://doi.org/10.1109/FIE.2013.6685151>
- Canney, N. E., & Bielefeldt, A. R. (2015a). A framework for the development of social responsibility in engineers. *International Journal of Engineering Education*, 31(1B), 414–424.

- Canney, N. E., & Bielefeldt, A. R. (2015b). Gender differences in the social responsibility attitudes of engineering students and how they change over time. *Journal of Women and Minorities in Science and Engineering*, 21(3).
- Canney, N. E., & Bielefeldt, A. R. (2016). Validity and reliability evidence of the engineering professional responsibility assessment tool. *Journal of Engineering Education*, 105(3), 452–477.
- Cech, E. A. (2013). Culture of Disengagement in Engineering Education? *Science, Technology, & Human Values*, 39(1), 42–72. <https://doi.org/10.1177/0162243913504305>
- Celio, C. I., Durlak, J., & Dymnicki, A. (2011). A Meta-Analysis of the Impact of Service-Learning on Students. *Journal of Experiential Education*, 34(2), 164–181. <https://doi.org/10.1177/105382591103400205>
- Christensen, L. J., Peirce, E., Hartman, L. P., Hoffman, W. M., & Carrier, J. (2007). Ethics, CSR, and Sustainability Education in the Financial Times Top 50 Global Business Schools: Baseline Data and Future Research Directions. *Journal of Business Ethics*, 73(4), 347–368. <https://doi.org/10.1007/s10551-006-9211-5>
- Coelho, M., & Menezes, I. (2021). University Social Responsibility, Service Learning, and Students' Personal, Professional, and Civic Education. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.617300>
- Corley, E. A., Kim, Y., & Scheufele, D. A. (2016). Scientists' Ethical Obligations and Social Responsibility for Nanotechnology Research. *Science and Engineering Ethics*, 22(1), 111–132. <https://doi.org/10.1007/s11948-015-9637-1>
- Cruz, N. I., & Giles, D. E. (2000). Where's the community in service-learning research. *Michigan Journal of Community Service Learning*, 7(1), 28–34.
- Delve, C. I., Mintz, S. D., & Stewart, G. M. (1990). Promoting values development through community service: A design. *New Directions for Student Services*, 1990(50), 7–29. <https://doi.org/10.1002/ss.37119905003>
- Eyler, J. (2002). Reflection: Linking Service and Learning—Linking Students and Communities. *Journal of Social Issues*, 58(3), 517–534. <https://doi.org/10.1111/1540-4560.00274>
- Eyler, J., Giles Jr, D. E., Stenson, C. M., & Gray, C. J. (2001). *At A Glance: What We Know about The Effects of Service-Learning on College Students, Faculty, Institutions and Communities, 1993-2000: Third Edition* (p. 122). Higher Education.
- Fiesler, C., Friske, M., Garrett, N., Muzny, F., Smith, J. J., & Zietz, J. (2021). Integrating Ethics into Introductory Programming Classes. *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education*, 1027–1033. <https://doi.org/10.1145/3408877.3432510>
- Fleddermann, C. B. (2000). Engineering ethics cases for electrical and computer engineering students. *IEEE Transactions on Education*, 43(3), 284–287. <https://doi.org/10.1109/13.865202>
- Harris, C. E., Pritchard, M. S., James, R. W., Englehardt, E. E., & Rabins, M. J. (2019). *Engineering ethics: Concepts and cases* (Sixth edition). Cengage.
- Herkert, J. (2000). Engineering ethics education in the USA: Content, pedagogy and curriculum. *European Journal of Engineering Education*, 25(4), 303–313. <https://doi.org/10.1080/03043790050200340>
- Hess, J. L., & Fore, G. (2018). A Systematic Literature Review of US Engineering Ethics Interventions. *Science and Engineering Ethics*, 24(2), 551–583. <https://doi.org/10.1007/s11948-017-9910-6>
- Howland, S. J., Claussen, S., Jesiek, B. K., & Zoltowski, C. B. (2022). Influences on U.S. undergraduate engineering students' perceptions of ethics and social responsibility: Findings from a longitudinal

- study. *Australasian Journal of Engineering Education*, 0(0), 1–12.
<https://doi.org/10.1080/22054952.2022.2154009>
- IEEE. (1996). *IEEE Code of Ethics*. Institute of Electrical and Electronics Engineers (IEEE).
- Jones, E., Leask, B., Brandenburg, U., & de Wit, H. (2021). Global Social Responsibility and the Internationalisation of Higher Education for Society. *Journal of Studies in International Education*, 25(4), 330–347. <https://doi.org/10.1177/10283153211031679>
- Kifle, B. M. (2020). *Characterizing disengagement in undergraduate education at MIT* [Thesis, Massachusetts Institute of Technology]. <https://dspace.mit.edu/handle/1721.1/127413>
- Kohlberg, L. (1984). *The psychology of moral development: The nature and validity of moral stages*. Harper & Row.
- Kreth, Q., Schiff, D. S., Lee, J., Borenstein, J., & Zegura, E. (2022). Social Responsibility Attitudes Among Undergraduate Computer Science Students: An Empirical Analysis. *2022 ASEE Annual Conference & Exposition*. 2022 ASEE Annual Conference & Exposition, Minneapolis, MN.
- Lin, A., & Loui, M. C. (2017). *Students' perceptions of the social responsibilities of engineers*. 1–4. <https://doi.org/10.1109/FIE.2017.8190645>
- Meadows, L., & Jarema, S. (2006). An Evaluation Of The Impact Of A Service Learning Project In A Required First Year Engineering Course. *2006 Annual Conference & Exposition Proceedings*, 11.185.1-11.185.15. <https://doi.org/10.18260/1-2--1109>
- Mitcham, C., & Englehardt, E. E. (2019). Ethics Across the Curriculum: Prospects for Broader (and Deeper) Teaching and Learning in Research and Engineering Ethics. *Science and Engineering Ethics*, 25(6), 1735–1762. <https://doi.org/10.1007/s11948-016-9797-7>
- Mitchell, T. D. (2008). Traditional vs. Critical Service-Learning: Engaging the Literature to Differentiate Two Models. *Michigan Journal of Community Service Learning*, 14(2).
<http://hdl.handle.net/2027/spo.3239521.0014.205>
- Naphan-Kingery, D. E., Miles, M., Brockman, A., McKane, R., Botchway, P., & McGee, E. (2019). Investigation of an equity ethic in engineering and computing doctoral students. *Journal of Engineering Education*, 108(3), 337–354. <https://doi.org/10.1002/jee.20284>
- Natarajarathinam, M., Qiu, S., & Lu, W. (2021). Community engagement in engineering education: A systematic literature review. *Journal of Engineering Education*, 110(4), 1049–1077. <https://doi.org/10.1002/jee.20424>
- National Academy of Engineering. (2009). *Ethics Education and Scientific and Engineering Research: What's Been Learned? What Should Be Done? Summary of a Workshop*. The National Academies Press. <https://doi.org/10.17226/12695>
- Oakes, W. C., Titus, C., Zoltowski, C. B., May, J. L., & Huyck, M. (2011). The Creation of Tools for Assessing Ethical Awareness in Diverse Multi-Disciplinary Programs. *2011 ASEE Annual Conference & Exposition*, 22.1436.1-22.1436.17. <https://peer.asee.org/the-creation-of-tools-for-assessing-ethical-awareness-in-diverse-multi-disciplinary-programs>
- Pence, G. E. (2021). *Medical ethics: Accounts of ground-breaking cases* (Ninth edition). McGraw-Hill Education.
- Pritchard, M. S., & Tsang, E. (2000). *Service Learning: A Positive Approach To Teaching Engineering Ethics And Social Impact Of Engineering*. 5.544.1-5.544.5. <https://peer.asee.org/service-learning-a-positive-approach-to-teaching-engineering-ethics-and-social-impact-of-engineering>
- Rest, J. R., Narvaez, D., Thoma, S. J., & Bebeau, M. J. (2000). A Neo-Kohlbergian Approach to Morality Research. *Journal of Moral Education*, 29(4), 381–395. <https://doi.org/10.1080/713679390>

- Robinson, P., Lee, N. D., & Carrick, D. (2008). *Ethics Education in the Military*. Ashgate Publishing, Ltd.
- Rulifson, G., & Bielefeldt, A. (2018). Influence of Internships on Engineering Students' Attitudes about Socially Responsible Engineering. *2018 IEEE Frontiers in Education Conference (FIE)*, 1–6. <https://doi.org/10.1109/FIE.2018.8658647>
- Ryan, M. (2012). *Service-Learning After Learn and Serve America: How Five States Are Moving Forward* (p. 28). Education Commission of the States. <https://www.ecs.org/clearinghouse/01/02/87/10287.pdf>
- Schiff, D. S., Logevall, E., Borenstein, J., Newstetter, W., Potts, C., & Zegura, E. (2021). Linking personal and professional social responsibility development to microethics and macroethics: Observations from early undergraduate education. *Journal of Engineering Education*, *110*(1), 70–91. <https://doi.org/10.1002/jee.20371>
- Severino-González, P., Gallardo-Vázquez, D., Ortuya-Poblete, C., Romero-Argueta, J., Tunjo-Buitrago, E., Arenas-Torres, F., & Sarmiento-Peralta, G. (2022). Social Responsibility: Sustainable Development Goals and COVID-19—Perception Scale of Students from Higher Education Institutions. *International Journal of Environmental Research and Public Health*, *19*(9), 5323. <https://doi.org/10.3390/ijerph19095323>
- Solbrekke, T. D., & Englund, T. (2011). Bringing professional responsibility back in. *Studies in Higher Education*, *36*(7), 847–861. <https://doi.org/10.1080/03075079.2010.482205>
- The National Institutes of Health, The Centers for Disease Control and Prevention, & The Agency for Toxic Substances and Disease Registry. (2011). *Principles of Community Engagement (2nd edition)* (No. 11–7782; p. 197). CDC/ATSDR Committee on Community Engagement. <https://www.atsdr.cdc.gov/communityengagement/>
- Vanasupa, L., & Schlemer, L. T. (2014). Relational versus Transactional Community Engagement: An Experience of the Benefits and Costs. *2014 ASEE Annual Conference & Exposition*, 24.1037.1-24.1037.11.
- Ward, K., & Wolf-Wendel, L. (2000). Community-centered service learning: Moving from doing for to doing with. *American Behavioral Scientist*, *43*(5), 767–780.
- Woods, M. (2005). Nursing Ethics Education: Are we really delivering the good(s)? *Nursing Ethics*, *12*(1), 5–18. <https://doi.org/10.1191/0969733005ne754oa>

Appendices for The Impact of Community Engagement on Undergraduate Social Responsibility Attitudes

Studies in Higher Education

Daniel S. Schiff, Department of Political Science, Purdue University, West Lafayette, IN, USA;
ORCID: 0000-0002-4376-7303; Corresponding author: dschiff@purdue.edu

Jeonghyun Lee: Center for 21st Century Universities, Georgia Institute of Technology, Atlanta, GA, USA; ORCID: 0000-0003-1497-0561

Jason Borenstein: School of Public Policy, Georgia Institute of Technology, Atlanta, GA, USA;
ORCID: 0000-0002-1505-4349

Ellen Zegura: School of Computer Science, Georgia Institute of Technology, Atlanta, GA, USA;
ORCID: 0000-0002-4756-1759

Table of Contents

Appendix A: Participants, Survey Administration, and Non-Random Sampling Bias Analysis	22
Methodological orientation and broader project	22
Survey administration and survey instrument	22
Study participants and construction of demographic variables	22
Appendix B: PSRDM Construct Reliability Testing	27
Appendix C: Discipline-based CE, Peer-based CE, and Overall CE	29
Survey items for CE constructs	29
Formative measurement approach	30
Appendix D: Analysis Approach Benefits and Limitations	31
Rationale for analysis approach	31
Study limitations	31
Appendix E: Additional Results and Descriptive Statistics	32
Appendix F: Additional Regression Results for CE Impact on PSRDM Scores	34
Appendix G: Survey Instrument	35
References	43

Appendix A: Participants, Survey Administration, and Non-Random Sampling Bias Analysis

Methodological orientation and broader project

While data collected using the Generalized Professional Responsibility Assessment (GPRA) constitute the primary source for this paper's analyses, they are only part of a broader project employing an integrated mixed methods design. In the context of this paper, the integrated mixed methods design as described in Leech & Onwuegbuzie (2009), involved the use of qualitative methods within the longitudinal design to shed further light on and inform the development of the quantitative analysis approach presented here. In particular, findings from the qualitative portion of the project—a collection of student interviews from a subset of our primary cohort—led to the identification of themes and refinement of survey questions related to student community engagement (CE) activities and other experiences that influence student social responsibility attitudes. For example, our focus on discipline-based CE and peer-based CE emerged from the broader project including prior qualitative findings (Schiff et al., 2021)

Survey administration and survey instrument

The study was reviewed and approved by the university's Institutional Review Board. As the key component of data collection, students in this cohort were recruited through an email invitation sent by a research team member followed up by several email reminders. The same cohort was sent an updated version of the survey in 2019, minus the individuals who no longer attended the university.

In terms of the survey design, no changes to the primary PSRDM measures themselves were made between the 2017 and 2019 administrations. However, the 2019 version of the survey was updated from the 2017 version to ask about college instead of high school CE experiences, with the particular activities written to reflect the context at the university, e.g., specific student groups that exist at the university. In addition, we removed three questions from the original instrument from our analysis to improve construct reliability, as discussed in Appendix B. The full version of the 2017 survey instrument is available at https://d8-sls.oit.gatech.edu/sites/default/files/2023-02/ga_tech_gpra-firstyearstudents.pdf and the 2019 version is reproduced in Appendix F.

Study participants and construction of demographic variables

Importantly, student demographic data are presented and aggregated in relatively coarse detail so as to preserve student privacy and because some characteristics were not measured by the university at a finer level of detail (e.g., gender/sex was provided as a binary variable). Of note then, some of the student data, such as major and first-generation status, were acquired through administrative channels at the university rather than through the survey. Further, due to small sample sizes for some student subgroups, our analyses focus on subgroups where the proportion of students in each subgroup is balanced enough to warrant a higher degree of confidence in the results.

As a result, we aggregate most demographic variables into binary measures (i.e., White vs. non-White) for both pragmatic and theoretical reasons:

- Gender was provided by administrative data in binary fashion (male or female) and subsequently treated as a binary variable in our analyses.
- In terms of Race/Ethnicity, institutional data categorized race/ethnicity as White, Asian, Hispanic or Latino, Black or African American, Multiracial, and Unknown. Of note, Hispanic ethnicity was not differentiated from race in administrative data. Given sample size limitations to allow for reliable inference, and to protect student confidentiality, we code Race/Ethnicity as White or non-White. This imperfect classification allows us some examination of potential differences between majority and underrepresented minority groups; however, future research with larger sample sizes would be important to understanding subgroup differences more robustly.
- For College, students belonged to one of six colleges with more than two dozen separate majors. Given the institution's status as an engineering college, due to small sample sizes for individual majors, and because of research on differences between engineering and non-engineering students, we code college as engineering or non-engineering. These data and designations come from administrative sources; we did not use our survey questions about future profession to construct the College measure. Of note, we use students' mid-point rather than entering major, since the former is more solidified for students. Table A1 provides additional details on student college and major.
- For Country of Origin, the student population in the sample is overwhelmingly from the United States, and small sample sizes from other countries do not allow for reliable analysis. As such, we combine non-US origins and code Country of Origin as USA or International.
- First-Generation student status was provided through administrative data as a binary variable, and is analyzed in this fashion.
- Regarding the religious affiliation status variable (i.e., Religious), a response option of "Religious, affiliated with an organized religion" was coded as "Yes" while response options including "Spiritual but not affiliated with an organized religion", "Atheist", "Indifferent or not religious" were coded as "No". No participant responded "Prefer not to say" in our data, though this was an option in the survey.

Overall, the sample ($n = 128$ respondents) as depicted in Table 1 in the main paper is roughly split between males (53%) and females (47%). About 55% of the students identify as White, with the remaining students consisting of: 20% Asian, 7% Hispanic or Latino, 5% Black or African American, 4% Multiracial, and 10% Unknown. 62% major in an engineering field, 94% grew up primarily in the United States, 3% are first-generation students, and 52% identify as religious.

Table A1. Distribution of Student College and Major at Mid-Point of Undergraduate Education

College & Major	#	College & Major	#
College of Computing	17	College of Sciences	15
Computer Science	17	Biochemistry	4
College of Design	3	Biology	5
Architecture	1	Mathematics	1
Industrial Design	2	Neuroscience	3
College of Engineering	79	Psychology	2

Aerospace Engineering	16	College of Liberal Arts	9
Biomedical Engineering	19	Computational Media	1
Chemical & Biomolecular Eng	14	Economics	1
Civil Engineering	3	Int'l Affairs & Mod Lang	2
Computer Engineering	3	International Affairs	1
Electrical Engineering	2	Lit., Media, & Communication	3
Environmental Engineering	4	Public Policy	1
Industrial Engineering	2	College of Business	5
Materials Science & Engr	2	Business Administration	5
Mechanical Engineering	11		
Nuclear & Radiological Engr	2		
Undeclared Coll of Engr	1	Grand Total	128

To provide further context, Table A2 compares our primary student sample analyzed in this paper with the entire entering first-year cohort. The sample is generally quite reflective of the larger student body at the university, though international students are underrepresented amongst our respondents (6% vs. 10%), females are modestly overrepresented (47% vs. 43%), and first-generation students are somewhat underrepresented (3% vs. 6%). While representativeness of our sample to our university is not of critical importance, as external validity of our sample will vary based on the comparison point (e.g., another university student population), it can provide additional understanding about our results. In the subsection below, we present the more relevant comparison towards understanding possible attrition and sampling bias: between students who took the first survey, and students who persisted and took both surveys.

Table A2. Comparison of Study Sample and Entire Student Body

Key Demographic Variables	Study Sample (n=128)	All First Year Students (2017) (n=2,990)
Gender		
<i>Male</i>	53%	57%
<i>Female</i>	47%	43%
Race/Ethnicity		
<i>White</i>	55%	52%
<i>Non-White</i>	45%	48%
College		
<i>Engineering</i>	62%	57%
<i>Non-Engineering</i>	38%	43%
Country of Origin		
<i>USA</i>	94%	90%
<i>International</i>	6%	10%
First Generation		
<i>Yes</i>	3%	6%
<i>No</i>	97%	94%

Non-random sampling bias analysis

An important question is whether the students who completed both surveys differ meaningfully from the students who completed the first round of the survey, as non-random sampling resulting from attrition could induce bias and threaten the generalizability of the results. To assess this, we used a multivariate logistic regression analysis (Goodman & Blum, 1996) to determine whether the covariates and, importantly, pre-college social responsibility scores of students in the initial sample would predict whether students stay or leave in the sample. The dependent variable of our regression model is a binary indication of whether a participant responded to the given survey at both time points (i.e., stayers) or responded at Time 1 only (i.e., leavers). The independent variables included the demographic variables gender, race/ethnicity, first generation to attend college, international student status, religious affiliation status, and college (e.g., engineering, liberal arts, business, etc.), and the three realms of student 2017 PSRDM scores (i.e., personal social awareness, professional development, and professional connectedness).

We found that for almost all of the included predictor variables, the logistic regression coefficients were statistically insignificant, indicating these variables are unlikely to play a role in predicting sample attrition. The exception is that being a male student was a statistically significant and substantial negative predictor of a student’s likelihood of completing the second survey. However, a *t*-test revealed that the gender variable had no statistically significant effect on the mean difference between stayers ($M = .47, SD = .50$) and leavers ($M = .55, SD = .50$), $t(835) = 1.610, p = .108$, suggesting that the effect of non-random sampling associated with gender would be negligible. Overall, while the results of our logistic regression model cannot definitively rule out the possibility of non-random attrition, for example based on unobserved characteristics, it provides some comfort regarding the similarity of the analytical sample with the broader student population and thus the generalizability of the sample.

Table A3. Results of Multivariate Logistic Regression to Detect Non-Random Sampling Bias

Variable	B	S.E.	Wald	Sig.	Exp (B)
Male	.682	.221	9.480	.002	1.977
White	-.061	.243	.063	.802	1.063
First Gen.	-.785	.619	1.610	.205	.456
USA	-.750	.534	1.972	.160	.472
Religious	-.129	.205	.392	.531	.879
Engineering	-.119	.208	.330	.566	.888
Pre-college PSA	.374	.253	2.177	.140	1.454
Pre-college PD	.257	.185	1.929	.165	1.293
Pre-college PROC	-.146	.199	.540	.462	.864
Constant	-5.030	1.439	12.219	.000	.007

Note. $\chi^2(9) = 25.383, p = 0.003$, with a Cox-Snell R^2 of .031 and Nagelkerke R^2 of .053.

Additionally, a Kolmogorov-Smirnov test was performed to test for normality of the distribution of PSRDM 2019 scores, the main dependent variable of our statistical models. The results showed that there was no

significant evidence to reject the null hypothesis that the variable is normally distributed ($p > .05$). The test results further indicated that the PSRDM 2019 scores were normally distributed within each of the demographic variable sub-groups.

Appendix B: PSRDM Construct Reliability Testing

For the three realms of the PSRDM, students answered 45 questions related to either Personal Social Awareness (e.g., whether they feel there are needs to address in their community), Professional Development (e.g., whether people in their intended profession can have a positive impact on society), or Professional Connectedness, (e.g., whether they feel called by the needs of society to pursue their profession). Each realm is formed by averaging the associated construct scores listed in Table B1 below. Each construct is similarly formed by averaging individual responses to the underlying survey questions associated with each, which involved reversing certain negatively-worded questions. Finally, we construct a master social responsibility score, listed as PSRDM 2017 and PSRDM 2019, by averaging the scores across the three realms. These overall social responsibility scores thus primarily reflect professional social responsibility attitudes, though they incorporate elements of personal social responsibility as well through the Personal Social Awareness Realm.

We preserve consistency with the original validated version of the instrument used to measure social responsibility in the EPRA as much as possible. However, given that we made revisions to the original instrument to be applicable to non-engineers, there may be differences in the psychometric quality of the new instrument. As such, we calculated item-total statistics and present construct-level reliability scores for all eight constructs, in line with the approach used by Canney & Bielefeldt (2016). We considered the use of both Cronbach's alpha and McDonald's omega as reliability measures. Omega is less sensitive to varying numbers of sub-scale items and measurement error, but relies on a hierarchical structure not feasible with our small dataset (Hayes & Coutts, 2020; McDonald, 1999), including because it fails to converge with two-item models. Because the PSRDM instrument had been previously validated and relies on simple construct averages to derive realm scores, we instead opt for alpha to measure construct reliability. Note, however, that omega scores are highly similar when they are able to be estimated.

While most constructs had acceptable reliability levels as measured by Cronbach's alpha, we removed two questions from the Analyze construct (an3, an4), and one from the Professional Ability construct (pa3).⁵ These adjustments improved the reliability of the Analyze construct from 0.26 to 0.62 and the reliability for the Professional Ability construct from 0.37 to 0.47. Of note, we are unable to calculate reliability score for the Base Skills construct as it is composed of a single item. Overall then, and despite these improvements to the refined measurement approach, the Professional Development realm should be interpreted with caution given lower reliability scores. Details including initial and final factor reliability calculations are presented in Table B1.

⁵ **an3** = I would not change a design or recommendations because they conflicted with community feedback. **an4** = It is important for people in my intended profession to consider the potential broader impacts of technical solutions to problems. **pa3** = Technology does not play an important role in solving society's problems.

Table B1. Construct and realm reliability scores for PSRDM instrument, including modifications

PSRDM realm	Construct	Number of items (final number)	Cronbach's alpha (final alpha)
Personal Social Awareness (PSA)	1. Awareness (aw)	5	0.65
	2. Ability (ab)	4	0.75
	3. Connectedness (co)	4	0.80
	<i>PSA realm overall</i>	13	0.77
Professional Development (PD)	1. Base Skills (ba)	1	—
	2. Analyze (an)	4 (2)	0.26 (0.62)
	3. Professional Ability (pa)	4 (3)	0.37 (0.47)
	<i>PD realm overall</i>	9 (6)	0.36 (0.51)
Professional Connectedness (PROC)	1. Professional Connectedness (pc)	19	0.92
	2. Costs-Benefits (cb)	4	0.78
	<i>PROC realm overall</i>	23	0.86

Appendix C: Discipline-based CE, Peer-based CE, and Overall CE

Survey items for CE constructs

The continuous measure of CE is available for both the 2017 and 2019 surveys, though the specific community service activities used to create the respective CE measures vary across the surveys, as they reflect pre-college versus college experiences. The 2017 version of the survey which asks about high school community service activities is directly based on the EPRA survey instrument; the 2019 version is adapted to focus on college experiences, including some that are specific to the institution (e.g., student clubs at the university). For this paper, we focus on CE activities that took place during college, and thus list below the survey questions from the 2019 version of the tool used to construct the three measures of CE. Of note, the overwhelming majority of these CE activities are voluntary, rather than requirements of the institution. The full version of the 2017 survey instrument is available at <https://serve-learn-sustain.gatech.edu/institutional-transformation-project> and the 2019 version is reproduced in Appendix F and available at <https://onlineethics.org/cases/evaluation-tools/generalized-professional-responsibility-assessment-gpra>.

The construction of the variables related to disciplinary focus or peer involvement is in part subjective. While discipline-based CE was an initial theoretical focus of the broader research project that shaped the survey design approach, the attention to peers emerged from qualitative work during the course of the project and is arguably less well defined. It is possible some individual CE activities might not fit into the relevant categories as we have defined them. Nevertheless, we feel these distinctions are generally accurate in the context of the institution. For example, in our determination that CE related to internships and research are best associated with discipline-based CE, we drew on our knowledge of the institution that most student internships and research projects emerge from a student's major or internships within their primary professional path. As another example, Living Learning Communities may involve activities that relate to a student's future profession. However, they are typically interdisciplinary and most of the activities are voluntary at our institution, with themes around issues like "global leadership" or "grand challenges." Students also join and leave the Living Learning Communities in the first year of their undergraduate education, arguably before their disciplinary focus has matured. As such, we felt the peer-based aspect was substantially more relevant than a possible disciplinary connection.

For each survey question below, we asked students how frequently (e.g., never, weekly, monthly, etc.) they participated in CE activities related to the following categories:

Discipline-based CE is constructed using responses to the following survey items:

- Community service activities connected to a course within your major
- Undergraduate research related to community service (e.g., in a Vertically Integrated Project, PURA, or independent research)
- On-campus internship or work related to community service
- Community service activities through a campus chapter of a professional organization (e.g., ASCE, BMES, or IEEE)
- Community service activities through a campus profession-oriented organization dedicated to social good (e.g., Engineers Without Borders, Epic Intentions, or Bits of Good)

Peer-based CE is constructed using responses to the following survey items:

- Community service activities through a campus Living Learning Community or other dormitory
- Community service activities through a campus fraternity or sorority
- Community service activities through a campus religious organization
- Community service activities through another type of campus organization (e.g., sports club, arts/dance team, or political group)]

Overall CE includes all of the survey items above along with responses to the following:

- Community service activities connected to a course outside your major
- Attending a speaker series, workshop, or conference related to community service
- Community service activities through a campus chapter of a general service-oriented organization (e.g., Habitat for Humanity, Hands on Atlanta, or Trees Atlanta)
- Community service activities not connected to a campus event, course, or organization (e.g., unpaid tutoring of elementary school children or volunteering at a soup kitchen or nursing home)
- Other

Formative measurement approach

Another note about the psychometric conceptualization of our approach to CE is in order. In particular, researchers have conceptually distinguished two different types of measurement models, namely reflective and formative (Jarvis et al., 2003) measurement. In the reflective (i.e., principal factor) model, which is a commonly used measurement model, a latent construct is hypothesized to affect covariation among a set of indicators that are assumed to be equally valid and internally consistent manifestations of the underlying construct. Distinctly, the formative (i.e., composite latent variable) model assumes that various quasi-independent measures influence and cause changes in a single construct such that these measures may or may not covary. In other words, in formative models, causality flows from the indicators to the construct, implying that adding or removing certain measures could change the conceptual meaning of the resulting construct.

Coltman et al. (2008) further present a framework to design and validate formative measurement models, using both theoretical justification and empirical testing given the proposed causal relationships between constructs and their measures. The research argues that use of a formative model is theoretically sound when the causality goes from the indicators to the domain of interest, and in a constructivist sense, conceptually represent the construct. In light of these theoretical distinctions and given our focus on these novel forms of CE, we consider the formative approach most appropriate in conceptualizing our measurement of CE. That is, the various CE activities listed above are combined to define discipline-based CE or peer-based CE as distinct types of CE engagement. However, the reliability and validity of these novel constructs of CE, including as a formative rather than reflective measure, requires further testing. For example, Coltman et al. (2008) recommend performing tests of collinearity, nomological validity, and evaluating structural linkage with another criterion variable.

Appendix D: Analysis Approach Benefits and Limitations

Rationale for analysis approach

For our primary data analysis approach, we adopted OLS regression and additionally control for student pre-college social responsibility scores, which we determined serve as strong predictors of social responsibility scores during college. This allows us to take advantage of our longitudinal dataset while emphasizing the effect of CE activities which take place *during college* on the development of social responsibility attitudes. Note that this lagged regression approach is functionally similar to using change scores for the key dependent variable under some conditions. However, the latter approach may be less reliable and sensitive to the phenomenon of regression to the mean, especially when autocorrelation is likely (Castro-Schilo & Grimm, 2018; Valente et al., 2017). We also prefer the lagged regression approach to other conventional panel data analysis approaches such differences-in-differences or first-differences estimation, as the lagged regression approach improves external validity by considering inter-individual variability. In contrast, fixed-effects models estimate effects based solely on within-individual changes, do not allow for direct estimation of time-invariant factors like student demographics, and are more suitable for more pure experimental or quasi-experimental interventions and settings (Allison, 2009; Bertrand et al., 2004; Collischon & Eberl, 2020). Because we are limited to two time periods, and given our interest in understanding and reporting on both demographic and college-level factors influencing social responsibility development, we consider OLS with baseline score adjustment more appropriate for our purposes. Statistical tests were conducted using SPSS Statistics and R software suites.

Study limitations

As discussed in the paper, our study is subject to various limitations which we expand on here. To elaborate on the limitations related to our sample, it is worth noting that, while only approximately 5% of the primary cohort completed both surveys, these response rates are not unusual for college students (Nair et al., 2008; Porter & Umbach, 2006). Further, given our sample demographic characteristics, we have some confidence that the students surveyed are reflective of the larger student population at our university. Nevertheless, unique demographic, cultural, regional, and institutional characteristics associated with our sample mean that the results found here may not generalize to other settings. For example, our university has a large proportion of engineering students and is located in an urban setting. This is an unavoidable limitation for a single university study, implying that future work may be needed to reproduce the results.

In terms of limitations related to our analysis approach, while the use of multivariate OLS and longitudinal survey data help us more confidently assess causal impacts of CE on social responsibility, our study is most safely understood as descriptive rather than strictly causal. Social responsibility development over time is the result of many complex and interconnected personal, institutional, and experiential characteristics. It is therefore difficult to causally and quantitatively isolate any particular factor or set of factors like CE. When examining such a multi-faceted process—as opposed to, for example, student development resulting from a single ethics course—our research team felt that it was necessary to apply a variety of methodologies for data collection and analysis. Thus while our prospects for confidently identifying causal relationships are limited in the context of this paper, we hope to build scholarly knowledge on CE and social responsibility development through conversation and triangulation across our projects and methodological approaches.

Appendix E: Additional Results and Descriptive Statistics

Table E1 Non-parametric correlation (Spearman R) coefficients among key variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	
1. Male	—																
2. White	-.03	—															
3. USA	-.02	.22*	—														
4. First Gen	.01	-.02	.05	—													
5. Engineering	.16	.03	-.07	-.14	—												
6. Religious	.07	.03	.07	-	-.02	—											
				.19*													
7. Overall CE	-	.10	.05	-.03	-.07	.04	—										
8. Discipline CE	-	-.02	-.01	.01	-.11	-.07	.73**	—									
9. Peer CE	-.15	-.07	.003	-.05	-.11	.15	.64**	.33**	—								
10. PSA 17	-	.07	.10	-.04	-.09	.09	.26**	.22*	.10	—							
	.28**																
11. PD 17	-	.04	-.01	-.09	-.16	.02	.12	.26**	-.01	.45**	—						
	.31**																
12. PROC 17	-	.07	-	-.11	-.08	.10	.38**	.36**	.23**	.76**	.51**	—					
	.48**		.003														
13. PSA 19	-	.06	.12	-.07	-.10	.17	.26**	.23**	.19*	.63**	.38**	.58**	—				
	.29**																
14. PD 19	-	.19*	.21*	.13	-.11	-.06	.34**	.37**	.14	.40**	.46**	.43**	.58**	—			
	.30*																
15. PROC 19	-	.16	.12	-.05	-.14	.11	.38**	.29**	.24**	.62**	.37*	.75**	.71**	.55**	—		
	.47**																
16. PSRDM 17	-	.07	.02	-.07	-.10	.13	.33**	.36**	.13	.84**	.73**	.89**	.61**	.49**	.68**	—	
	.40**																
17. PSRDM 19	-	.17	.14	-.01	-.11	.11	.36**	.33**	.20*	.65**	.44**	.69**	.88**	.77**	.89**	.69**	—
	.39**																

Note. * indicates $p < .05$, ** $p < .01$, and *** $p < .001$.

Table E2 Wilcoxon signed-rank test results: PSRDM Realms and Overall PSRDM

	Personal social awareness (PSA)	Professional development (PD)	Prof connectedness (PROC)	Overall PSRDM
Avg pre score	6.08	6.34	5.52	5.99
Avg mid-college score	6.05	6.34	5.47	5.95
<i>p</i> value	0.73	0.85	0.31	0.51
N students increased	58	57	59	64
N students decreased	64	58	65	64
N students unchanged	5	13	0	0

Note. A Wilcoxon signed-rank test showed that there was no significant change in PSA, PD, PROC, and PSRDM between pre-college and mid-college scores. Totals may not sum to 128 in some cases given missing responses from some respondents.

Table E3 Wilcoxon signed-rank test results: PSRDM Constructs

	Personal social awareness (PSA)			Professional development (PD)			Prof connectedness (PROC)	
	Aware	Ability	Conn	Base skills	Analyze	Prof ab	ProfCon	Cost/Ben
Avg pre score	6.43	5.98	5.84	6.41	6.08	6.52	5.43	5.61

Avg mid-college score	6.50	5.83	5.83	6.62	5.96	6.43	5.41	5.51
<i>p</i> value	0.09	0.04	0.80	0.02	0.15	0.20	0.95	0.10
N students increased	57	42	42	36	36	43	58	47
N students decreased	38	59	53	17	50	46	54	55
N students unchanged	29	25	28	75	42	39	3	22

Note. A Wilcoxon signed-rank test showed that, within the PSA realm, there was a significant negative change in Ability scores between pre-college and mid-college. Additionally, there was a significant positive change in Base Skills scores within the PD realm.

Table E4 *T* test results by gender

	Male (n=60)		Female (n=68)		<i>t</i> -test	Cohen's <i>d</i>
	M	SD	M	SD		
Overall CE	37.15	47.47	67.97	75.08	-2.733**	.484
Discipline-based CE	13.85	28.18	28.28	32.91	-2.646**	.469
Peer-based CE	9.70	15.64	12.44	16.22	-.970	.172
PSA 2017	5.90	.66	6.25	.61	-3.174**	.562
PD 2017	6.22	.53	6.46	.71	-2.067*	.366
PROC 2017	5.07	.81	5.91	.73	-6.160***	1.100
PSRDM 2017	5.73	.54	6.21	.50	-5.184***	.918
PSA 2019	5.85	.66	6.23	.60	-3.440**	.612
PD 2019	6.20	.57	6.46	.66	-2.308*	.409
PROC 2019	5.05	.80	5.82	.76	-5.579***	.997
PSRDM 2019	5.71	.56	6.17	.53	-4.816***	.853

Note. * indicates $p < .05$, ** $p < .01$, and *** $p < .001$. For Cohen's *d*, a value of 0.2 represents a small effect size, a value of 0.5 represents a medium effect size, and a value of 0.8 represents a large effect size. Tables E4 and E5 use a *t*-test instead of a non-parametric test because normality test results indicate that PSRDM 2019 scores are normal across these demographic sub-groups.

Table E5 *T* test results by race/ethnicity

	White (n=70)		Non-White (n=58)		<i>t</i> -test	Cohen's <i>d</i>
	M	SD	M	SD		
Overall CE	59.29	65.31	46.57	65.09	1.098	.195
Discipline-based CE	24.91	34.81	17.41	26.70	1.345	.239
Peer-based CE	10.89	16.20	11.48	15.77	-.210	.037
PSA 2017	6.13	.62	6.04	.69	.775	.138
PD 2017	6.36	.58	6.32	.71	.395	.070
PROC 2017	5.57	.81	5.45	.96	.794	.142
PSRDM 2017	6.02	.53	5.94	.63	.748	.133
PSA 2019	6.09	.64	6.01	.67	.636	.113
PD 2019	6.44	.49	6.21	.75	2.130*	.378
PROC 2019	5.59	.85	5.32	.87	1.792	.321
PSRDM 2019	6.04	.58	5.85	.58	1.883	.334

Note. * indicates $p < .05$, ** $p < .01$, and *** $p < .001$. For Cohen's *d*, a value of 0.2 represents a small effect size, a value of 0.5 represents a medium effect size, and a value of 0.8 represents a large effect size.

Appendix F: Additional Regression Results for CE Impact on PSRDM Scores

Figure F1 shows coefficient plots for estimating the effect of three different types of CE (i.e., overall, peer-based, discipline-based) on four measures of social responsibility attitudes, including overall PSRDM and three realms of PSRDM (i.e., personal social awareness, professional development, and professional connectedness). The subfigures depict standardized regression coefficients (marked by dots) with 95% confidence intervals (marked by horizontal lines) of the individual CE variables. Each model holds constant student covariate variables, including gender, race/ethnicity, major, country of origin, religiosity, and first generation status, as with Figure 4 in the main text.

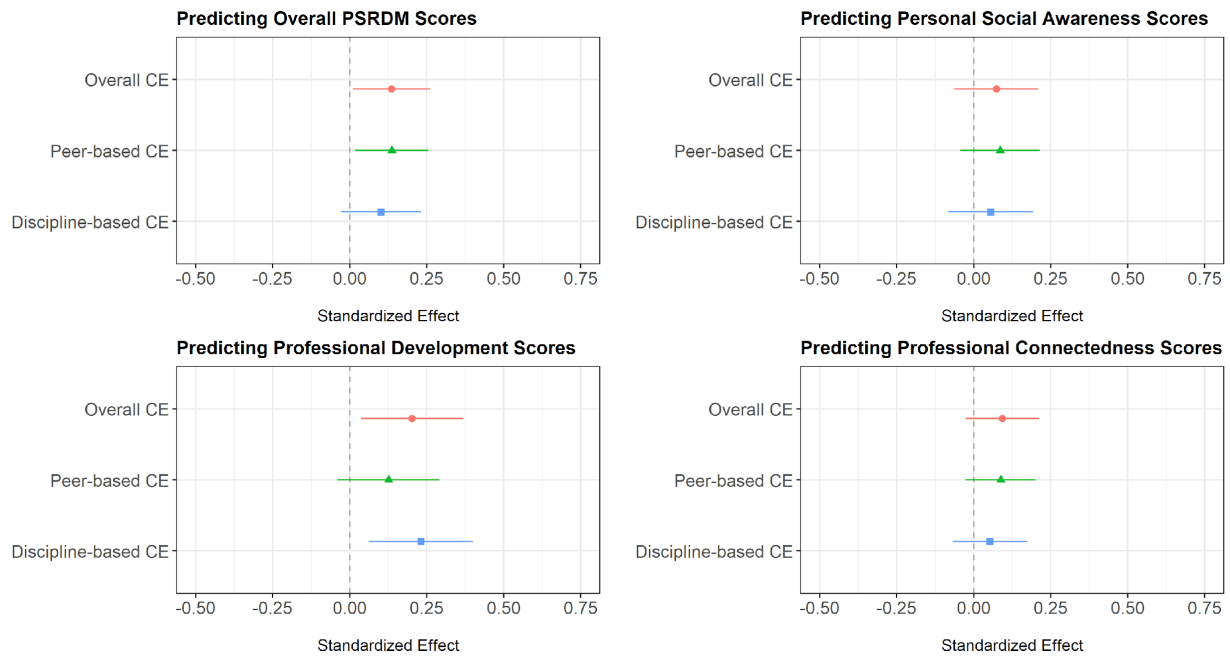


Figure F1. Coefficient plots for estimating the effect of different types of CE on social responsibility attitudes, including all PSRDM realms.

The purpose of this figure is to evaluate the magnitude of estimated effects of the different CE variables on relevant PSRDM outcomes. Figure F1 indicates that none of the three CE variables had a significant effect in predicting scores of either personal social awareness or professional connectedness, indicated by the confidence intervals crossing the zero line. In contrast, overall CE and peer-based CE (but not discipline-based CE) predicted overall PSRDM scores, while overall CE and discipline-based CE (but not peer-based CE) predicted professional development scores.

Because of our special interest in discipline-based CE's potential role in impacting PD and our focus on overall SR attitudes, we focus in the main manuscript on PD and on overall PSRDM. However, these additional results in Appendix F can help to reveal further effects and limitations of the CE measures. In particular, a more complicated question that we do not resolve in this paper is why different forms of CE might affect PD but not, for example, PSA. Results also indicate that the effects on PD are responsible for driving effects on overall PSRDM scores, as overall PSRDM scores are a simple average of realms scores.

Appendix G: Survey Instrument

Appendix F includes the complete survey items that constitute the Generalized Professional Responsibility Assessment (GPRA), as well as questions related to CE, student demographics, and other items about student professional paths and preferences. This version of the survey is publicly available as well at https://serve-learn-sustain.gatech.edu/sites/default/files/images/ga_techgpra1.1-midpointversion.pdf . The 2017 or ‘first-year’ version of the instrument is available at https://d8-sls.oit.gatech.edu/sites/default/files/2023-02/ga_tech_gpra-firstyearstudents.pdf and includes more detail on the correspondence between survey items and PSRDM constructs and realms.

Which profession is closest to what you plan on pursuing in the future?

- Architecture, Arts or Design
 - Business or Economics
 - Communications, Media or Entertainment
 - Computing
 - Engineering
 - Law or Public Policy
 - Medicine or Health
 - Science
 - Other _____
-

[The questions in the two blocks below constitute the primary validated measures of the instrument, as well as a single attention check question. To see how the items correspond to PSRDM constructs and realms as described in the paper, please see <https://onlineethics.org/cases/evaluation-tools/generalized-professional-responsibility-assessment-gpra> and <https://serve-learn-sustain.gatech.edu/institutional-transformation-project/>.]

Please rate how important you think the following skills are in your intended profession using the scale below:

	1 - Very Unimportant	2 - Unimportant	3 - Slightly Unimportant	4 - Neutral	5 - Slightly Important	6 - Important	7 - Very Important
Professional ethics (ensuring all of your work follows professional codes of conduct)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Societal context (how your work connects to society and vice versa)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volunteering (for professional and personal reasons)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cultural awareness / understanding (of your culture, and those of others)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate the level to which you agree/disagree with the following statements using the scale below:

	1 - Strongly Disagree	2 - Disagree	3 - Slightly Disagree	4 - Neutral	5 - Slightly Agree	6 - Agree	7 - Strongly Agree
People in my intended profession have contributed greatly to fixing problems in the world	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would not change a design or recommendations because they conflicted with community feedback	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volunteer experiences have changed the way I think about spending money	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is important to me to have a career that involves helping people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The skills in my intended profession are not useful in making the community a better place	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is important for people in my intended profession to consider the potential broader impacts of technical solutions to problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Service should not be an expected part of my intended profession	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would be willing to have a career that earns less money if I were serving society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will use the skills gained from my intended profession to help others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I view my intended profession and community service work as unconnected	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel called to serve others through my intended profession	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The needs of society have no affect on my choice to pursue my intended profession	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technology does not play an important role in solving society's problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My professional skills are strengthened through participation in service opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel called by the needs of society to pursue my intended profession	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I doubt that volunteer work will ever have much effect on my career	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think it is important to use the skills gained from my intended profession to serve others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People in my intended profession can have a positive impact on society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People in my intended profession should use their skills to solve social problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is important to use my professional abilities to provide a useful service to the community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe that I will be involved in social justice issues for the rest of my life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not think it is important to use skills gained from my intended profession to serve the greater community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe my life will be positively affected by the volunteering that I do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can make a difference in my community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
America does not have communities that need help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think people who are more fortunate in life should help less fortunate people with their needs and problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe that extra time spent on community service is worthwhile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is not my responsibility to do something about improving society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe it takes more than time, money, and community efforts to change social problems: we also need to work for change at a national or global level	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community groups need our help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are not people in the community who need help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can have an impact on solving problems that face my local community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is important to me to have a sense of contribution and	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

helpfulness through participating in community service							
Please mark "3 - Slightly Disagree" if you are reading this question	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is my responsibility to take some real measures to help others in need	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel an obligation to contribute to society	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are people who have needs which are not being met	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My contribution to society will make a real difference	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think I should help people who are less fortunate with their needs and problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I cannot have an impact on solving problems that face underserved communities internationally	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are needs to address in the community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helping others is a central message in my intended major	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[The following block was modified from the first-year version to better apply to college related CE activities, and to the context at the university where the study is taking place. Other researchers who wish to use the activities below may wish to modify them for their own context.]

"Community Service" is a phrase that covers a range of activities, such as volunteering, service learning, and research projects on important societal issues. The activity could, for example, help support a local community or work towards solving a global issue that affects the public's well-being.

Rate the typical frequency that you have engaged in any of the following community service activities during your time at [university] using the scale below:

	0 - Have not participated	1 - Only a few times during college	2 - Once or Twice per year	3 - More than twice per year but not routinely	4 - Monthly	5 - Weekly
Community service activities connected to a course within your major	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Community service activities connected to a course outside of your major	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Undergraduate research related to community service (e.g., in a Vertically Integrated Project, PURA, or independent research)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Long-term on-site service project through a campus organization (e.g., disaster relief or spring break service trip)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
On-campus internship or work related to community service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attending a speaker series, workshop, or conference related to community service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community service activities through a campus Living Learning Community or other dormitory	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community service activities through a campus chapter of a professional organization (e.g., ASCE, BMES, or IEEE)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community service activities through a campus profession-oriented organization dedicated to social good (e.g., Engineers Without Borders, Epic Intentions, or Bits of Good)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community service activities through a campus chapter of a general service-oriented organization (e.g., Habitat for Humanity, Hands on Atlanta, or Trees Atlanta)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community service activities through a campus fraternity or sorority	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community service activities through a campus religious organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community service activities through another type of campus organization (e.g., sports club, arts/dance team, or political group)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community service activities not connected to a campus event, course, or organization (e.g., unpaid tutoring of elementary school children or volunteering at a soup kitchen or nursing home)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What are the reasons that you have participated in community service activities during your time at [university]? Check all that apply.

- Required for a class
 - To travel (e.g., for an international experience)
 - To spend time with friends/a social group
 - Because I was encouraged to do so as a member of a student organization
 - It makes me feel good
 - Because of my religious beliefs
 - To help others
 - To gain new skills connected to my future profession
 - To build my resume/get a job
 - Because I think people in my future profession have a professional obligation to do so
 - Other _____
-

Did any of the community service activities you participated in during your time at [university] overlap with what you intend to do as your future profession?

- Yes (briefly explain) _____
 - No
-

Did community service activities during your time at [university] increase your awareness of how your future profession can support the public's well-being?

- Yes
 - No
 - Not applicable
-

Did community service activities during your time at [university] increase your ability to use your professional skills to support the public's well-being?

- Yes
 - No
 - Not applicable
-

Did community service activities during your time at [university] increase your sense of your professional obligation to support the public's well-being?

- Yes, these activities increased my sense of professional obligation
 - No, these activities decreased my sense of professional obligation
 - No, these activities had no significant effect on my sense of professional obligation
 - Not applicable
-

Future Job Qualities: Below there are 8 bins with different job qualities on them. You have 10 stones to distribute among the bins to mark which qualities are important to you when thinking of your future job. You may place multiple stones in any bin, but you must place exactly 10 stones in total and no fractional stone distributions are allowed. **Write your number of stones in the square on each bin.**

Salary : _____
Helping People : _____
Working on Industrial/Commercial Projects : _____
Working on Community Development Projects : _____
Living Domestically : _____
Living Internationally in a Developed Country : _____
Living Internationally in a Developing Country : _____
Own Your Own Business (Be Self-Employed) : _____
Total : _____

[The survey instrument also includes some demographic questions. Other demographic data were acquired through administrative sources.]

Did you grow up primarily outside of the U.S.?

- Yes
 - No
-

How would you describe your religious affiliation or preference?

- Religious, affiliated with an organized religion (i.e. Christian, Muslim, Jewish, Hindu, Buddhist, etc.)
 - Spiritual but not affiliated with an organized religion (i.e. Humanist, Agnostic, etc.)
 - Atheist
 - Indifferent or not religious
 - Prefer not to say
-

How active do you consider yourself in the practice of your religious preference?

- Very Active
 - Somewhat Active
 - Not very Active
 - Not Active
 - Does not apply/ Prefer not to say
-

References

- Allison, P. D. (2009). *Fixed Effects Regression Models*. SAGE Publications.
- Bertrand, M., Duflo, E., & Mullainathan, S. (2004). How Much Should We Trust Differences-In-Differences Estimates?*. *The Quarterly Journal of Economics*, *119*(1), 249–275. <https://doi.org/10.1162/003355304772839588>
- Borenstein, J., Newstetter, W., Potts, C., & Zegura, E. (2019). *Generalized Professional Responsibility Assessment (GPRA)*. Online Ethics Center for Engineering.
- Castro-Schilo, L., & Grimm, K. J. (2018). Using residualized change versus difference scores for longitudinal research. *Journal of Social and Personal Relationships*, *35*(1), 32–58. <https://doi.org/10.1177/0265407517718387>
- Collischon, M., & Eberl, A. (2020). Let's Talk About Fixed Effects: Let's Talk About All the Good Things and the Bad Things. *KZfSS Kölner Zeitschrift Für Soziologie Und Sozialpsychologie*, *72*(2), 289–299. <https://doi.org/10.1007/s11577-020-00699-8>
- Coltman, T., Devinney, T. M., Midgley, D. F., & Venaik, S. (2008). Formative versus reflective measurement models: Two applications of formative measurement. *Journal of Business Research*, *61*(12), 1250–1262. <https://doi.org/10.1016/j.jbusres.2008.01.013>
- Goodman, J. S., & Blum, T. C. (1996). Assessing the Non-Random Sampling Effects of Subject Attrition in Longitudinal Research. *Journal of Management*, *22*(4), 627–652. <https://doi.org/10.1177/014920639602200405>
- Hayes, A. F., & Coutts, J. J. (2020). Use Omega Rather than Cronbach's Alpha for Estimating Reliability. But... *Communication Methods and Measures*, *14*(1), 1–24. <https://doi.org/10.1080/19312458.2020.1718629>
- Jarvis, C. B., MacKenzie, S. B., & Podsakoff, P. M. (2003). A Critical Review of Construct Indicators and Measurement Model Misspecification in Marketing and Consumer Research. *Journal of Consumer Research*, *30*(2), 199–218. <https://doi.org/10.1086/376806>
- Leech, N. L., & Onwuegbuzie, A. J. (2009). A typology of mixed methods research designs. *Quality & Quantity*, *43*(2), 265–275. <https://doi.org/10.1007/s11135-007-9105-3>
- McDonald, R. P. (1999). *Test theory: A unified treatment* (pp. xi, 485). Lawrence Erlbaum Associates Publishers.
- Nair, C. S., Adams, P., & Mertova, P. (2008). Student Engagement: The Key to Improving Survey Response Rates. *Quality in Higher Education*, *14*(3), 225–232. <https://doi.org/10.1080/13538320802507505>
- Porter, S. R., & Umbach, P. D. (2006). Student Survey Response Rates across Institutions: Why Do they Vary? *Research in Higher Education*, *47*(2), 229–247. <https://doi.org/10.1007/s11162-005-8887-1>
- Schiff, D. S., Logevall, E., Borenstein, J., Newstetter, W., Potts, C., & Zegura, E. (2021). Linking personal and professional social responsibility development to microethics and macroethics: Observations from early undergraduate education. *Journal of Engineering Education*, *110*(1), 70–91. <https://doi.org/10.1002/jee.20371>
- Valente, T. W., Sidhu, A. K., Lee, J., Baezconde-Garbanati, L., Pandol, S., Saab, S., Mendler, M., & Tsukumoto, H. (2017). Lagged Versus Difference Score Regression: An Example From a Community-Based Educational Seminar Evaluation. *Pedagogy in Health Promotion*, *3*(4), 239–245.