JOURNAL OF HIGHER EDUCATION OUTREACH & ENGAGEMENT

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REFLECTIVE ESSAY

From the Editor…

Shannon O. Brooks

It's getting hot out there as we settle into summer. Perfect timing for the latest issue, 25(2), of the *Journal of Higher Education Outreach and Engagement*, which has turned into a true "summer blockbuster." This issue is chock full of new scholarship featuring 15 articles covering a diverse range of topics and methodologies, interestingly, with a decidedly international flair. Contributing authors from Australia, Singapore, Ecuador, Ireland, London, Slovenia, and Canada, as well as research studies conducted in Brazil and Ghana add new dimensions to community engaged scholarship outside of the U.S. higher education context. Over the last three years, the number of manuscript submissions from international authors has steadily increased, and *JHEOE* is all the better for these international voices and perspectives.

The Research Articles section in this issue present empirical studies on a wide variety of topics from service-learning to STEM outreach. Leading off this section are two studies examining important elements of service-learning development—institutionalization and faculty development. First, Ti, Tang, and Bringle address a gap in the literature on service-learning institutionalization at non-Western universities through their case study of integrating service-learning as a "signature pedagogy" at Ngee Ann Polytechnic in Singapore. This article examines the process employed at this institution, using Furco's (2002) dimensions of institutionalization, and subsequently, how this evidence drove the creation of the "Service-Learning Roadmap," an institutional strategic plan. Following this important study and adding to the service-learning literature on faculty support and development, "Faculty Perspectives on Coeducation and Reciprocity," presents Darby, Cobb, and Willingham's study of 22 faculty members from a variety of disciplines, career tracks, and experience levels teaching service-learning courses. This study examines perceptions of how these faculty define coeducation and reciprocity and what associated tools and factors are important for developing successful partnerships. The findings provide evidence that can be used by other instituions to support service-learning faculty in their course design and implementation as they develop their roles as coeducators, and as they maintain reciprocal partnerships.

STEM focused outreach and community-based learning feature heavily in our next two research articles. First, Delaine analyzes STEM community-based learning (CBL) across two case studies using a multiple-case study design, resulting in the development of a model with three system levels—community, program, and individual. This study, conducted at a public university for high-achieving students in Brazil, addresses a gap in scholarship by exploring a systems level approach to understanding CBL and the actions, goals, and impact of practitioners. Further adding not only to the STEM but also the international perspective of this issue, Reed, Prieto, Burns, and O'Connor also present findings from a pivotal decade-long evaluation of the Science and Engineering Challenge (SEC) program, a STEM outreach program hosted by the University of Newcastle, Australia. This impressive study of over 7,000 high school and college students, analyzed the affect participation in SEC had on pursuing STEM degrees in college, among other factors.

Concluding the Research Articles section, Medved and Ursic author a multiple case study project with urban planning focused university–community partnerships in the European Union. The intention of this research was to identify the mutual benefits of university–community partnerships, and in particular to highlight the "university added value" in such partnerships.

Despite this treasure trove of research articles that further extend the scholarship of engagement, the star of this issue is

the journal's robust Projects with Promise section, which features nine articles that present findings and impact of early- to midstage outreach and engagement studies. First, Hidayat and Stoecker explore a project-based research model applied to environmental issues in "Collective Knowledge Mobilization Through a Community–University Partnership." This method is designed to be a more authentic model led by the community rather than traditional knowledge-transfer models, which the authors argue are hallmarks of university outreach partnerships but are not actually partnerships. This study explores lessons learned from a three-year academic partnership that took place over a series of capstone courses.

Other articles in this section explore outreach and community engagement interventions with diverse populations, including K–12 and youth, senior citizens, individuals experiencing homelessness, and marginalized women seeking post-secondary access. Padgaonkar and Schafer discuss a program model for conducting STEM outreach to senior citizens with the goal of increasing science literacy for this active voting group. "Role Model Moms Post-Secondary Academy" by Wright, Wang, Goldstein, Thibodeau, and Nyhof-Young describes the development and evaluation of an intervention hosted by the University of Toronto designed to increase post-secondary access focused on marginalized women with children who need support completing their GED and accessing post-secondary options. At the other end of the aging spectrum, Susnara, Berryhill, Ziegler, and Betancourt examine a mixed method study conducted over two years with parents who participated in the University of Alabama's Pre-Kindergarten Parent Leadership Academy using pre- and post-test results examining parents' school leadership behaviors, self-efficacy, and capacity building for effective parent-teacher relationships and parental involvement. A youth focused study by Mongue and Colyott examines a partnership between the University of Kansas and the Girl Scouts of Northeast Kansas/Northwest Missouri on attitudes toward insects after an outreach intervention designed to address fears and misperceptions of insects. Finally, "Sight and Sole: Partnering to Enhance the Health of the New Britain Homeless" explores findings by Christensen and McKelvey from a program between nursing faculty and students at Central Connecticut State and local homeless service providers to provide vision and foot care to homeless individuals. Four goals for the project were evaluated: 1) health improvement of homeless served; 2) engagement of students in service-learning; 3) increased student understanding of health disparities, ability, and advocacy; and 4) alignment with Carnegie's definition of community engagement. The expansiveness of each of these studies focused on different populations signals the growing vitality and relevance of community engagement in higher education around the world, and the importance of the scholarly methods being pioneered through this community-based work.

The international voices and context continue with Yepez-Reyes and Williams' two year outreach and service-learning partnership between the College of Communication at Pontificia Universidad Católica del Ecuador (PUCECom) and Ohio University's Game Research and Immersive Design (GRID) Lab. This study explores the potential of immersive technologies for digital storytelling and promoting collaboration in service-learning applications, as well as lessons learned from an international partnership. This study is followed by "Perceptions of a Higher Education Informal Science Learning Program in an International Context," a case study of an international marine science-focused informal science learning program, The Coastal Ocean Environment Summer School in Ghana. Using a mixed methods approach, researchers examine the impact on participants' perceptions of research abilities, attitudes toward marine science, knowledge of marine sciences, and the professional development of instructors involved. Finally, this "mega" section concludes with Arnold, Barrett, Campbell, Chrysochoou, and Bompoti's findings from the first four years of development and implementation of the the E-Corps (Environment Corps), a community-engaged scholarship model that combines service-learning course instruction, extension outreach, and integration across administrative functions at the University of Connecticut, all designed to benefit students, faculty, and the community.

This issue of *JHEOE* concludes with a Reflective Essay written by emerging scholars Kniffin, Van Schyndel, and Fornaro, who critically reflect upon their roles as chairs of the Graduate Student Network (GradSN)

affiliated with the International Association for Research on Service-Learning and Community Engagement (IARSLCE). This network is for graduate students whose scholarship is focused on service-learning and community engagement and seeks to be an inclusive and international organization. Using a collaborative autoethnographic approach, the authors examine their power and privilege in order to understand potential barriers to taking on leadership roles that might hinder other students from participation. This study provides insight into developing support in the field for potentially marginalized graduate students.

There is so much exciting new scholarship to explore in this issue of the *Journal of Higher Education Outreach and Engagement (JHEOE)*. Once again, we thank our associate and managing editors, reviewers, and authors who made this summer blockbuster issue possible. Thank you also, dear reader, for your support of academic publishing focused on university-community engagement. We hope you will be sufficiently inspired by the scholarship in these pages to consider contributing a manuscript to the journal and becoming a reviewer for future issues.

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Initiating and Extending Institutionalization of Service-Learning

Clarence B. W. Ti, Joyce Tang-Wong, and Robert G. Bringle

Abstract

Senior leadership at Ngee Ann Polytechnic in Singapore decided to make service-learning the signature pedagogy of the polytechnic and to infuse at least one service-learning module (i.e., course) in every diploma so that all students would have a service-learning experience. Evidence is provided that, in 3 years, the rapid institutionalization of service-learning met and exceeded all of Furco's (2002) dimensions for institutionalization at the quality building level, his intermediate level of institutionalization. In addition, a bold, visionary institutional strategic plan, the Service-Learning Roadmap, is presented that not only achieved this growth but also extends institutionalization beyond current models. Finally, implications and recommendations are offered to guide institutionalizing service-learning, thereby providing a model for other institutions globally.

Keywords: service-learning, institutionalization, civic engagement, strategic planning

Since the early 1990s, institutions of higher education around the world have been exploring ways to redefine their public missions (Bringle et al., 1999a; Dolgon et al, 2017; Global University Network for Innovation, 2014; McIlrath et al., 2012; McIlrath & MacLabhrainn, 2007; National Task Force on Civic Learning and Democratic Engagement, 2012; Saltmarsh & Hartley, 2011; Xing & Ma, 2010). Within the American context, Boyer (1990, 1994, 1996) challenged higher education to involve students in social issues, extend classrooms into communities, expand conceptions of scholarly work, engage in institutional change, and develop symbiotic relationships with communities. The expansion of this agenda beyond the American context, in turn, challenges institutions of higher education around the world to develop their own models of civic engagement in ways that reflect unique mission statements, institutional traditions and structures, historical and cultural context, and community assets (e.g., Aramburuzabala et al., 2019; Furco & Kent, 2019; Global University Network for Innovation, 2014; International Christian University, 2009; Ma & Chan, 2013; Ma et al., 2018; McIlrath et al., 2012; McIlrath & MacLabhrainn, 2007; Plater, 2017; Regina & Ferrara, 2017; Xing & Ma, 2010). Civic engagement can be defined as

> active collaboration that builds on the resources, skills, expertise, and knowledge of the campus and community to improve the quality of life in communities in a manner that is consistent with the campus mission. This indicates that this work encompasses teaching, research, and service (including patient and client services) in and with the community. (Bringle et al., 2007, pp. 61–62)

Not all activities in the community by members of the academy fit this definition of civic engagement because civic engagement is viewed as occurring not only in the community but also *with* the community.

A central component of revisioning civic engagement as collaborative activities has been rethinking teaching in ways that involve community members as coeducators

to design and implement service-learning courses that contribute to the development of civic-minded graduates who have lifelong habits of contributing to their communities (Hatcher, 2008; Steinberg et al., 2011). Figure 1 illustrates how the traditional functions of the academy (i.e., teaching, research, service) can occur in the community and that they can overlap. (The intersections of [a] teaching, research, and service and [b] teaching and research can occur both on campus and in the community, although they are not shown in this diagram.) Service-learning is the intersection of teaching and service and has the dual purposes of benefiting the community and fostering learning.

Service-learning, which is acknowledged as being a high-impact pedagogy (Finley, 2011; Kuh, 2008), provides a salient means for revising the curriculum to advance the civic mission of higher education, expand student learning, and enrich partnerships with communities. Meta-analyses support the value added by service-learning to different domains of student learning (Celio et al., 2011; Conway et al., 2009; Novak et al., 2007; Warren, 2012; Yorio & Ye, 2012). Finley (2011) found that service-learning (vs. the other high-impact pedagogies studied) had the greatest impact on learning, general education, personal development, and practical competence. Service-learning is the merger of teaching and learning in ways that expand the learning objectives to include civic learning within the context of the curriculum; it develops ways in which students and instructors can work in and with communities to the benefit of all (Bringle et al., 1999b). Service-learning is defined as

> a course-based, credit-bearing educational experience in which students (a) participate in mutually identified and organized service activities that benefit the community, and (b) reflect on the service activity in such a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of
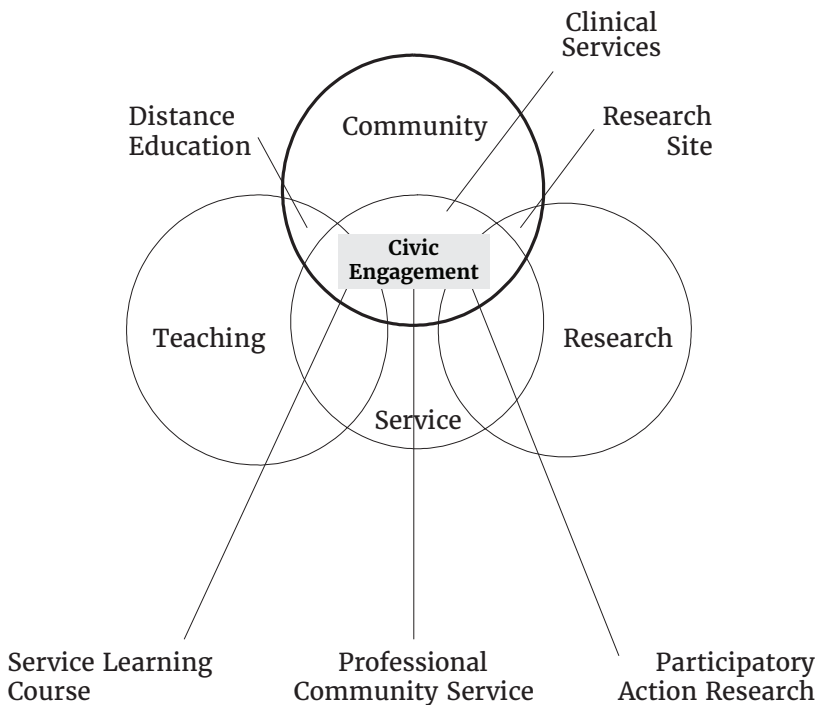
Engagement of Faculty Work in and with the Community

Figure 1. Civic Engagement as Faculty Work in the Community

Note. Adapted from Bringle, Games, & Malloy, 1999b, p. 5.

personal values and civic responsibility. (Bringle & Clayton, 2012, pp. 114–115; adapted from Bringle & Hatcher, 1996)

As service-learning becomes more prevalent around the world, the challenge is not only offering more and better service-learning courses but also institutionalizing service-learning, which goes beyond changing the curriculum on a course-by-course basis and includes institutional and organizational change to establish widespread campus support and participation. Evidence for achieving institutionalization of service-learning is found when

> it is part of the academic culture of the institution, aligns with the mission, becomes an enduring aspect of the curriculum that is supported by more than a few faculty, improves other forms of pedagogy, leads to other forms of civic scholarship, influences faculty roles and rewards, is part of the experience of most students, and has widespread support, understanding, and involvement of students, faculty, administration, and the community. (Bringle et al., 2001, p. 93)

Based on our familiarity with the literature (e.g., Aramburuzabala et al., 2019; International Christian University, 2009; Ma & Chan, 2013; McIlrath et al., 2012; McIlrath & MacLabhrainn, 2007; Meijs et al., 2019; Regina & Ferrara, 2017; Xing & Ma, 2010) and our work on service-learning in different regions of the world, we concluded that there are only a few examples outside North America of extensive institutionalization of service-learning across a campus through a centralized campus unit.

Bringle and Hatcher (1996) in their Comprehensive Action Plan for Service Learning (CAPSL) delineated four constituencies: institution, faculty, students, and communities. For each of these constituencies, they posited the following steps for advancing institutionalization of service-learning: planning, increasing awareness, identifying prototypes, acquiring resources, initiating activities that result in expansion, providing recognition, monitoring, conducting evaluation, conducting research, and institutionalization. Steps that are taken to advance the institutionalization of service-learning and the rate

of progress are influenced by many factors, but institutional type (e.g., 2-, vs. 3-, vs. 4-year vs. graduate institution; religious; private; public comprehensive; research intensive; metropolitan) is an important factor. Zlotkowski (1998) provided case studies of different approaches taken by different types of U.S. institutions. National and regional context also shapes service-learning. The Global University Network for Innovation (2014) presented overviews of work and case studies related to knowledge production, civic engagement, and service-learning for Africa, Arab States, Asia and the Pacific, Europe, Canada and North America, and Latin America and the Caribbean. Welch and Saltmarsh (2013) analyzed reports from 100 U.S. institutions that were recognized for their community engagement and identified key characteristics of community engagement centers and the types of activities in which they engaged to achieve institutionalization.

The purpose of this article is to provide an additional case study for the institutionalization of service-learning at a polytechnic institution in a non-Western setting. This article describes why and how senior leadership at Ngee Ann Polytechnic (NP) in Singapore decided to make service-learning the signature pedagogy of the polytechnic and to infuse at least one service-learning module ("module" is NP's term for course) in every diploma (i.e., degree program) so that every student would have completed a service-learning module during their course of study. The research question was whether or not there was evidence of institutionalization using Furco's (2002) dimensions for institutionalization to support the institutional steps taken by NP and, if so, at what level of institutionalization. In addition, the evidence for institutionalization provided a basis for a bold, visionary institutional strategic plan, the Service-Learning Roadmap, which extends institutionalization beyond current models (e.g., Bringle & Hatcher, 1996, 2000; Furco, 2002; Holland, 2001). Finally, implications and recommendations will be offered to guide institutionalizing service-learning at other institutions globally.

Background of Service-Learning at Ngee Ann Polytechnic

Ngee Ann Polytechnic (NP) has a student population of 14,000+ and offers 36 full-time diploma courses through nine aca-

demic schools and various part-time programs. NP emphasizes a holistic education that goes beyond textbooks and geographical boundaries. Programs are designed to enthuse students with a love for learning and equip them with the skills to thrive in the workforce of the future. Three mission hallmarks that distinguish NP students are (a) a passionate learner, (b) a big-hearted person, and (c) a global smart professional. Thus, the development of service-learning was aligned with NP's mission. The following sections provide a qualitative analysis of strategic steps taken to develop institutionalization of service-learning that are organized using the CAPSL model and quantitative evidence for the research question on assessing the degree of institutionalization.

Planning and Increasing Awareness

Consistent with Bringle and Hatcher's (1996) CAPSL framework that planning is a key early activity, the idea of adopting service-learning was first mooted in January 2015 as a follow-up to the Fourth NP Strategic Plan (2013–2022) to (a) develop a coherent and dynamic methodology that actively engages each and every student; (b) build a community of values-driven learners; and (c) create a supportive learning environment that promotes experiential, interactive, and borderless learning. NP's directors of academic units were in agreement that service-learning would support NP's graduate outcomes to produce students who are passionate learners, big-hearted persons, and global smart professionals. Service-learning, if well implemented, was viewed as developing students to be responsible, civic minded, and active citizens, as well as potential agents of social change in a world of increasing complexity and uncertainty. The decision was made to adopt the strategy that included the goal of every student having an opportunity to experience service-learning in at least one module from the academic year 2016 intake onward. A steering committee was set up in 2015, headed by the senior director/projects and with representatives from various departments and schools to coordinate training and curriculum advisement and to start the preparatory work to introduce the concept and pedagogy of service-learning to instructors. Bringle and Clayton's (2012) definition of service-learning was adopted as NP's institutional definition. Communications and updates to both internal and external stakeholders have been in the form of service-learning collaterals, webpages, social media (such as dedicated Facebook and LinkedIn accounts), enewsletters, and videos created on selected modules to highlight good practices.

Identifying Prototypes, Acquiring Resources, and Initiating Activities That Result in Expansion

In order to support the vision of NP for service-learning, the Office of Service-Learning (OSL) was established in October 2016 to lead and coordinate the activities to drive service-learning in five focused areas: capacity building, curriculum design, collaborations, communications, and developing student champions. The staff of NP's OSL currently consists of a head, three master trainers (overseeing curriculum design and capacity building), one staff member handling communications and collaborations, one staff member managing student volunteers, one staff member managing international service-learning programs, and two administrative support staff. Of these, five of the OSL staff are permanent, three are seconded based on an initial term of 2 years, and one is on a fixed-term contract. In addition, key on-site consultations were provided by Professor Robert G. Bringle of Indiana University–Purdue University Indianapolis and Professor William Oakes, director, EPICS Program and professor of engineering education, Purdue University.

In 2015, 70 staff were trained by an external consultant trainer as the pioneer cohort to implement service-learning as NP's signature pedagogy. Twenty-four service-learning modules were rolled out in 2016 enrolling about 2,000 students, and to date, 48 diplomas have at least one service-learning module and almost 17,000 students have had a service-learning module. During training, instructors were introduced to multiple strategies for reflection (e.g., group discussions, written products, project summaries, oral presentations). In addition, the DEAL model for critical reflection (Ash & Clayton, 2009) was identified as one of the structured reflection models introduced to instructional staff to facilitate reflection in service-learning modules. Efforts are under way to train more staff to use DEAL as one of the models for critical reflection within service-learning modules. OSL is also the centralized body at NP administering international service-learning programs. Every year, close to 600 students embark on about

28 cocurricular international service-learning trips. Most of the trips are led by staff from the respective schools and departments, with OSL leading some of the trips.

Recognition

On March 1, 2016, service-learning as NP's signature pedagogy was officially launched with an inaugural Service-Learning Awards Ceremony to recognize the early adopters of service-learning. Three categories of awards were launched: (a) Service-Learning Student Champions Awards; (b) Service-Learning Student Grants; and (c) Service-Learning Staff Champion Awards. The Service-Learning Award has been incorporated in NP's Staff Excellence Award as one of the award categories for instructional staff.

Monitoring, Conducting Evaluation, and Conducting Research

In 2017, a research study, "Impact of Service-Learning With Structured Reflections on Civic Outcomes, Academic Connections and Personal Growth in Polytechnic Students," was awarded a research grant by the Ministry of Education Tertiary Research Fund to study student outcomes for service-learning in the School of Humanities & Social Sciences. The 2-year research study examined 832 student participants from eight diploma programs. Of these, 351 participated in pretest surveys when they first joined the school before embarking on any service-learning module, and a posttest survey at the end of a service-learning module (Choo et al., 2019). A civic outcome score was measured with nine survey items that asked about interest in social issues, civic involvement, and involving others in communities. Results revealed that there was a significant difference in the students' perceived civic outcomes after taking the service-learning module. The 351 participants completing pretest–posttest surveys demonstrated significantly greater improvement in their civic outcomes scores in the service-learning (experimental) condition than the no-service-learning (control) condition (see Choo et al., 2019 for complete results). Key recommendations from the research included having a well-designed training program for module leaders, lecturers, and other stakeholders; supporting instructional staff in module implementation; increasing touch-points of interaction with the community; and strengthening the understanding of civic learning of both staff and students. The study affirmed that structured reflection was a key factor for enhancing civic outcomes, academic connections, and personal growth. In addition, the findings supported the conclusion that students were becoming more responsible, civic-minded, and active citizens, confirming the standing of service-learning as a high-impact pedagogy with the potential to develop the desired graduate outcomes.

Since 2017, a module experience survey with questions constructed to assess students' service-learning experiences has been conducted every semester over the past four semesters. The survey has six questions about students' enhanced understanding of module content, relevance of academic knowledge in the community context, reciprocity of engagement with the community, civic aspirations, insights gained from reflections, and student voice. The overall average of the six quantitative questions demonstrated an upward trend across the four semesters on a five-point scale (scores of 3.91, 4.07, 4.15, and 4.18, respectively), suggesting that the quality of service-learning outcomes was improving. Though it does not tell the whole story (Choo et al., 2019), the survey results supported the quality of the early service-learning modules and identified modules that needed more attention. This enabled the OSL trainers to work further with the respective module leaders on module improvement and staff training.

Evidence of Institutionalization

Although the journey of implementing service-learning as NP's signature pedagogy has been meaningful and fulfilling, the sustainability of the vision and activities depends on how well service-learning can be institutionalized so that the level of acceptance and commitment toward the vision is a shared common goal, rather than being entirely dependent on executive management and a small group of advocates. The process of institutionalizing service-learning is reflected in the buy-in and commitment from many different stakeholders, including senior management, instructors, administrative staff, students, and community and industry partners (Bringle & Hatcher, 1996; Welch & Saltmarsh, 2013).

Survey

Furco's (2002) Self-Assessment Rubric for the Institutionalization of Service-Learning

in Higher Education identifies the following components for institutionalizing service-learning: philosophy and mission of service-learning (definition of service-learning, strategic planning, alignment with institutional mission, alignment with educational reform efforts), faculty support for and involvement in service-learning (faculty knowledge and awareness, faculty involvement and support, faculty leadership, faculty incentives and rewards), student support for and involvement in service-learning (student awareness, student opportunities, student leadership, student incentives and rewards), community participation and partnerships (community partner awareness, mutual understanding, community partner voice and leadership), and institutional support for service-learning (coordinating entity, policy-making entity, staffing, funding, administrative support, departmental support, and evaluation and assessment). Furco's rubric identifies three stages of achievement: critical mass building, quality building, and sustained institutionalization.

A survey was constructed that presented respondents with each component of Furco's framework and asked them to indicate where they thought NP was on the rubric in terms of the development of service-learning on campus. The survey was distributed to NP administrators, school and departmental management, and instructional and support instructional staff. The response format included a slight modification of Furco's rubric: it gave respondents the opportunity to choose an intermediate response between critical mass and quality building, and between quality building and sustained institutionalization. The survey also asked respondents for their familiarity with service-learning using the following choices: (1) *No familiarity with Service-Learning*; (2) *Heard of Service-Learning but don't know much about it*; (3) *Some knowledge of Service-Learning*; (4) *Good knowledge about Service-Learning*; (5) *Provided consult and/or taught Service-Learning modules, have extensive knowledge of the theory and practice of Service-Learning.*

Results

Responses to the survey were obtained from 106 participants: six top management; 22 directors and heads; 26 deputy directors and assistant directors; 43 service-learning course/module leaders and instructional

staff; and nine support staff. Single-sample t-tests were used to answer the question "Was rated institutionalization significantly greater than 3.0 (i.e., quality building level)?" The survey results demonstrated that, in 3 years, the rapid institutionalization of service-learning significantly exceeded the quality building level (3.0 on the 5.0 scale) for all five of Furco's components of institutionalization:

- philosophy and mission of service-learning, mean = 3.99, $t(105)$ = 13.03, p < .01;

- faculty support for and involvement in service-learning, mean = 3.42, t(105) = 5.23, p < .01;

- student support for and involvement in service-learning, mean = 3.37, t(105) = 4.05, p < .01;

- community participation and partnerships, mean = 3.20, t(105) = 2.18, p < .05; and

- institutional support for service-learning, mean = 3.84, $t(105)$ = 9.64, p < .01.

In addition, the correlation between familiarity and the total institutionalization score (i.e., summed across Furco's five dimensions) was nonsignificant, $r(104)$ = .19, p > .05.

Discussion

Although Furco's rubric has been used as a means for engaging a campus in discussions and strategic planning for developing enhanced institutionalization, this research used it as a measure of institutionalization, much like Bringle and Hatcher (2000) did when they used their CAPSL model to assess differences in institutional support for service-learning. As Furco and Miller (2009) noted,

> An assessment process provides the means to conduct a status check of the campus's overall current level of community engagement institutionalization by offering a structure and framework for collecting and reviewing information so that informed decisions can be made about an institution's engagement strengths and weaknesses. (p. 48)

To our knowledge, this is the first use of

Furco's rubric to measure institutionalization in a setting outside North America (Furco, 2007, used a related rubric in the United States). In addition, this research on NP's institutionalization is unique in the type of evidence of institutionalization of service-learning that was collected for an institution outside North America. Virtually all other case studies of institutionalization of service-learning have been anecdotal, with little empirical evidence of institutionalization (e.g., Ma et al., 2018; Meijs et al., 2019; Xing & Ma, 2010).

Furco (2007) concluded that no progress was seen on 43 campuses that had been working toward institutionalization of service-learning for 3 years. In addition, Furco and Miller (2009) concluded that institutionalizing community engagement would take 15 years. In contrast, NP demonstrated significant advancement in 3 years of work to institutionalize service-learning. Although the data collected on institutionalization are limited in answering any questions about why NP's institutionalization was so rapid, the steps NP took are well aligned with the CAPSL planning framework. Ti et al. (in press) suggested that the following early steps were important: centralized strategic planning, endorsing service-learning as a signature pedagogy, establishing clear campus goals, and endorsement by upper and middle management. In addition, they and others (Bennett et al., 2016; Bringle & Hatcher, 1996, 2000; Furco, 2002; Holland & Furco, 2004; Vogel et al., 2010; Welch & Saltmarsh, 2013) have stressed the importance of internal funds to support a centralized office, staffing it with capable persons with service-learning experience, and engaging in capacity-building activities. Ti et al. (in press) described additional steps taken with students and community partners to support the institutionalization of service-learning. This evidence provides other institutions with a set of tools that can guide activities and that can be adapted through strategic planning to promote institutionalization.

The Service-Learning Roadmap

As part of the strategic planning process, in April 2018, the Service-Learning Roadmap was envisioned to help staff and students continue the journey to develop the three hallmark outcomes of the NP student—a passionate learner, a big-hearted person, and a global smart professional. The Service-Learning Roadmap consists of three phases (see Figure 2).

Phase 1: Build Foundations With Service-Learning as Signature Pedagogy

As previously detailed, NP adopted Bringle and Hatcher's (1996) CAPSL model and Bringle and Clayton's (2012) definition of service-learning to develop the institutional capacity to reach the goal of one service-learning module in every diploma. NP is one of the few institutions of higher learning outside North America that has made service-learning mandatory or, as we prefer to characterize it, an *integral* part of the entire campus's curriculum and all students' educational experience (National Task Force on Civic Learning and Democratic Engagement, 2012; Ti et al., 2020). The development of service-learning was heavily dependent on establishing a central office that oversaw many of the functions identified by Bringle and Hatcher (1996) and Welch and Saltmarsh (2013) as fundamental to institutionalizing community engagement and service-learning.

Not only was the goal of curricular integration of service-learning into each diploma program's curriculum achieved, but also the evidence from the survey demonstrated that the campus community at all levels endorsed the significance of service-learning as an integral part of the curriculum. In addition, the mean levels of NP's institutionalization for Furco's five components had the same rank order as the components that Bringle and Hatcher (2000) found for CAPSL based on 179 American campuses: highest institutionalization for institution > faculty > students > lowest for community. This is consistent with the advice that strategic planning and institutional infrastructure are important first steps in institutionalizing service-learning, and that engaging in activities directed at instructors is a critical early step for developing service-learning and support (Bringle & Hatcher, 1996). Although each campus is different and context matters, we think these results provide a basis for guiding the institutionalization of service-learning on other campuses through strategic planning at the campus level, the commitment of resources to curriculum development, and prioritizing activities.
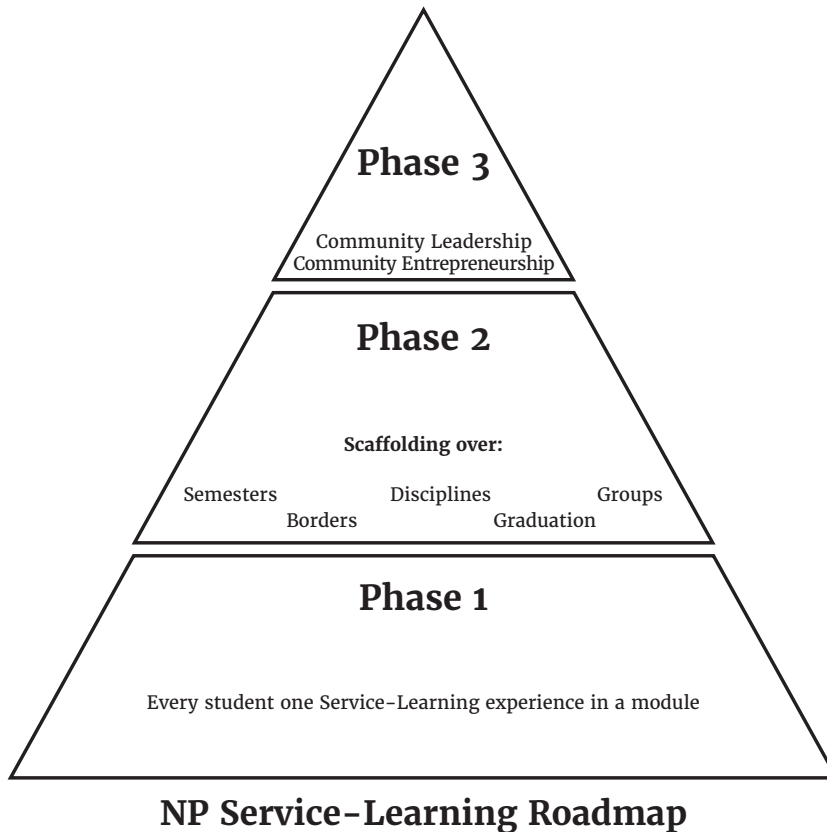
Figure 2. Ngee Ann Polytechnic's Service-Learning Roadmap

Phase 2: Scaffolding Service-Learning to Deepen and Broaden Service-Learning

Phase 1 is typically what institutions aspire to when they take steps to institutionalize service-learning. However, the Service-Learning Roadmap presents a vision beyond this level of achievement and extends previous frameworks of institutionalization (e.g., Bringle & Hatcher, 1996, 2000; Furco, 2002; Holland, 2001; Holland & Furco, 2004). Phase 2, currently being implemented, builds upon the goals of institutionalization from Phase 1 and extends institutionalization (e.g., breadth, depth, quality) to develop students' civic consciousness and engagement, curricular and cocurricular development, and community partnerships. Phase 2 identifies scaffolding of service-learning experiences as a key aspect of extended development of institutionalization. Here, *scaffolding* refers to the intentional sequencing of activities in ways that build upon and extend previous experiences. Phase 2 identifies five areas in which service-learning can be scaffolded.

1. Scaffold across semesters—students take more than one service-learning module across different semesters with enhanced academic and civic learning objectives in subsequent modules, including final year, capstone, and internship modules that address social issues.

2. Scaffold across disciplines—students from different disciplines come together to work on the same complex service-learning projects.

3. Scaffold across groups—community projects are longitudinally built upon from group to group within and across semesters.

4. Scaffold across the campus—connect service-learning projects to cocurricular activities and other campus initiatives.

5. Scaffold across borders—international service-learning modules are developed to complement domestic service-learning.

6. Scaffold beyond graduation—service-learning projects are developed in adult education and for alumni.

Phase 2 is designed to transcend the limitations of having students exposed to a single, compartmentalized service-learning module. Scaffolding aligns with the National Task Force on Civic Learning and Democratic Engagement's (2012) recommendation that "civic learning is infused across students' educational experiences over time in a developmental arc" (p. 43). The ultimate goal of scaffolding service-learning is to ingrain service-learning further into the culture of the institution and into community partnerships. Developing additional service-learning modules will expand the participation of instructional staff doing service-learning, further establish service-learning as an expected and regular part of the academic culture, and enhance the community understanding of civic engagement and service-learning. In addition, scaffolding sequential service-learning modules has the added advantage of building on students' civic attitudes and motives from previous experiences, allowing extension of course design parameters (e.g., reflection, assignments, readings) that build upon previous experiences, and permitting more complex learning objectives being intentionally designed into service-learning modules.

Scaffolding also has benefits for community partners. Communities care about outcomes that benefit the quality of life of community constituencies (Sandy & Holland, 2006). To implement at a community site multidisciplinary service-learning projects and service-learning activities that have continuity across semesters has the potential to enhance community support, build enduring partnerships, and increase community benefits.

Phase 3: Scale Impact More Broadly

Phase 3 is NP's aspiration to build community leadership and community entrepreneurship. As nations race to incorporate technology and intelligent decision-making into their cities, it becomes even more important to ensure that benefits of technology and globalization are shared across different socioeconomic classes and that the soul of a city–nation remains caring and inclusive. Though in unchartered territory, initial steps for Phase 3 have been taken toward this end. First, at the forum Our

Social Future—Innovating for Tomorrow in October 2018, eight speakers from industry shared thoughts about innovative ideas and solutions in the social space. The conference was attended by about 400 delegates from the educational, social, and governmental sectors.

Second, in 2019, NP launched the credit-bearing Civic Internship Program that supplements the existing credit-bearing Internship Programme and that enrolls an estimated 15% of third-year students (more than 600) and works with close to 50 community organizations. The initial group of participating organizations have come from the fields of (a) healthcare, (b) business and economics, (c) engineering and technology, and (d) social and environment. This program involves placements with an organization that provide students with opportunities not only to practice their professional skills but also to work on an assignment or project that promotes the public good. Community leaders and role models are invited to advise, inspire, and challenge the Civic Interns to greater civic engagement. This approach of integrating service-learning with internships into hybrid pedagogies (Bringle, 2017) reflects an additional example of more deeply embedding the civic outcomes of service-learning in the academic curriculum and campus culture.

Third, separately, organizations from institutions of higher learning and the social sector have approached NP to train their staff in the fundamentals of service-learning, and there are opportunities both locally and overseas to provide leadership through capacity building in this area. Phase 3 is an aspiration, and NP is developing the best strategies to move this phase forward.

Recommendations and Implications

Institutional Development

The pace of implementation of service-learning as NP's signature pedagogy over the 3 years was brisk. The mandate of every student having at least one service-learning module meant that staff had to be quickly trained, community partnerships had to be forged, definitions and jargon had to be articulated and clarified, materials and resources had to be acquired and developed, administrative systems and policies had to be put in place, and, most important,

buy-in from stakeholders at all levels had to be developed. The sustainability of service-learning must transcend simply developing more service-learning modules and include steps enabling the rationale and the philosophy of service-learning to become part of the institution's academic culture for civic engagement more broadly. All of this is possible because the campus invested in an OSL that was staffed with personnel familiar with teaching service-learning modules and capable of developing instructors' capacity to design and implement such modules. Therefore, based on this experience and past research (Bennett et al., 2016; Bringle & Hatcher, 1996, 2000; Furco, 2002; Holland & Furco, 2004; Vogel et al., 2010; Welch & Saltmarsh, 2013), we recommend that a key step in moving institutionalization along is forming a campus entity that can clearly assume primary responsibility for improving the quantity and quality of service-learning courses. Furthermore, based on the results of achieving Phase 1, we recommend that other institutions consider CAPSL or a similar framework for organizing strategic planning of activities to develop institutionalization. Strategic planning and activities must work at multiple levels of the institution: executive leadership, deans/program directors, instructors, and students (Welch & Saltmarsh, 2013). Past research evaluating these factors has been limited mostly to American institutions, and future research needs to be conducted to see if these findings generalize to other contexts and institutional types around the world.

In addition to Holland (1997) and Welch and Saltmarsh (2013) finding that organizational structure had the most significant impact on the level of institutional commitment, Bringle and Hatcher (2000) and Welch and Saltmarsh (2013) found that locating OSL infrastructure in academic affairs is an advantage to institutionalization. Consistent with this research and NP's experiences, we recommend that the infrastructure to support service-learning be located in academic affairs.

The evidence for the degree of stakeholder buy-in is reflected in the perceived institutionalization across Furco's five components of institutionalization. Furthermore, the lack of a correlation between ratings and familiarity indicates that this buy-in is pervasive and not restricted to those most familiar with NP's service-learning. Although the results of the survey revealed that the perceived level of institutionalization of service-learning exceeded the quality building level for all five components, there must be further deepening and broadening, especially in the areas of community participation and partnerships, and student support and involvement in service-learning (Ti et al., 2020). Much of this can be strengthened through activities in Phase 2. This suggests that institutions interested in promoting institutionalization of service-learning should establish mechanisms for monitoring the current status of institutionalization and the areas that could receive subsequent attention to broaden and deepen institutionalization.

Faculty Support for and Involvement in Service-Learning

Sandmann and Plater (2009) identified the following four areas for which executive leadership is important: using mission to situate civic engagement, developing goals, articulating strategic plans for achieving those goals, and communicating their commitment. NP's journey to date reflects the importance of each of these, including relating service-learning to each of the three components of NP's academic mission for students (i.e., a passionate learner, a big-hearted person, and a global smart professional), strategic planning across time that includes institutionalizing service-learning, implementing infrastructure such as the OSL, carefully selecting staff to lead the initiative, and advocating the rationale for service-learning in multiple venues. We conclude that institutionalization of service-learning builds upon the role of executive leadership, but that the endorsement and support of executive leadership is necessary but not sufficient for advancing institutionalization (Ti et al., 2020; Welch & Saltmarsh, 2013). We therefore recommend that other institutions develop the support and commitment of executive leadership to civic engagement and service-learning, while, at the same time, working to develop support throughout all levels of the institution. Too little research attention has been devoted to the roles that executive leadership and middle leadership (e.g., deans, directors, chairs) play in the institutionalization of service-learning, and these roles should be investigated in future research on institutionalizing service-learning.

The results also illustrate the importance of initially working with instructors to modify

the curriculum. As Wood (1990) pointed out, "Educational programs . . . need champions. Those champions must be found in the faculty if an innovation is to be profound and long-lasting. Administrators should not be shy about seeking out faculty champions" (p. 53). After establishing OSL, training instructors to understand, design, and implement service-learning in academic modules has been the key focus. More than 400 academic staff have been trained, and this is an ongoing effort. Developing mechanisms (e.g., workshops, one-on-one consultation, departmental meetings, expert consultants) to expand service-learning beyond the few early adopters is an important step. The next phase in capacity building will be to develop service-learning trainers within the respective schools to decentralize expertise and embed it in the context of the academic disciplines in a school. Therefore, we recommend that institutions look for ways to enhance the capacity of schools and departments to support service-learning, contribute to expansion of service-learning, and commit to a more sustained level of institutionalization of service-learning. The challenges of initiating and expanding service-learning provide institutions with opportunities to study the motives and obstacles for instructors who practice service-learning, instructors who try it and stop, and instructors who are not attracted to implementing service-learning (Banerjee & Hausafus, 2007).

Curricular Development

The presence of service-learning modules in all diplomas was a significant aspiration and achievement, in contrast to most approaches to service-learning development that are reactive to faculty interest and scattered unevenly across the curriculum (Bringle & Hatcher, 2009). Therefore, we recommend that other institutions engage in activities that improve the quality of all aspects of service-learning courses, enroll other instructors beyond the initial cohort, clarify civic learning outcomes for students, improve reflection assignments, and commit additional attention to community partners. Bringle and Hatcher (2009) also acknowledged the importance of linking service-learning to other campus curricular initiatives (mission, strategic planning, academic success, student retention) and cocurricular civic programs on campus. We recommend that institutions identify ways in which service-learning can enhance other

campus initiatives, rather than compete with them. Developing hybrid pedagogies that integrate service-learning with other high-impact pedagogies (Bringle, 2017), such as civic internships and international service-learning modules, and thinking about how service-learning and community engagement can be continued with alumni and integrated into continuing education initiatives are examples of building upon the institutional goals for service-learning beyond its initial implementation.

The monitoring, assessment, and research supported by NP's Ministry of Education grant provided a significant early step that made it possible to ascertain the students' perceptions of the quality of the service-learning modules (Choo et al., 2019). CAPSL describes developing the capacity for monitoring and evaluating the quality of service-learning as an important component of institutionalization because doing so can identify areas that warrant future improvement and provide a basis for establishing the efficacy of service-learning to internal and external audiences. Subsequent attention to direct evidence of student learning and evidence of community outcomes will strengthen the case.

Community Participation and Partnerships

The rapid implementation over the 3 years meant that many community partnerships and projects had to be very quickly negotiated, and most of them would have started at a basic level. Although Choo et al. (2019) found strong support from a survey of some community partners, it was not unexpected that campus respondents to the survey perceived community participation and partnership as an area that could be further developed (Bringle & Hatcher, 2000; Welch & Saltmarsh, 2013). Faced with challenges such as large cohorts (some diploma cohorts have 500 to 600 students in service-learning modules), relevance of a module's academic content in addressing community issues, completion of projects within the academic semester, and coordinating schedules of both students and identified community members, it was considered a good start. However, good institutionalization of service-learning warrants the development and refinement of partnerships for maintaining community participation and support as well as student and instructor fulfillment (Sandy & Holland,

2006). The OSL is currently developing and preparing to implement a new survey for all service-learning community partners. We recommend to other institutions that they advocate for community partners to be coeducators before, during, and after a service-learning course is designed and implemented. In addition, it is important to develop mechanisms for monitoring and evaluating community partnerships. This type of information will provide a basis for studying the quality of relationships that have formed, the transitions that occur in these relationships over time, and community perspectives on service-learning activities (Bringle et al., 2009).

In Phase 2, the strategies to scaffold students' service-learning engagement and experiences will allow for deepening and broadening community participation and partnerships. The strategy to scaffold projects across groups of students and across semesters will mean that different groups of students from different cohorts and disciplines can work with community partners on larger and more complex projects that address a similar theme. We therefore recommend intentional dialogue and consultation with community partners to cocreate projects and activities to increase the involvement of the community partners in terms of awareness, community voice, mutual understanding, and assessment. Doing so should result in greater impact for the service activities rendered to the community and the learning outcomes of the students. For example, in some NP training to date, community partners have codesigned staff training programs with OSL staff (Ti et al., 2020). Such collaboration will contribute to, enhance, and confirm what research shows community partners value most about their association with service-learning: being coeducators of students (Sandy & Holland, 2006).

Student Support and Involvement in Service-learning

This category of Furco's (2002) framework includes student awareness, student opportunities, student leadership, and student incentives and rewards. One reason for the lower score on this component (vs. institutional development) on the campus survey could be the limited channels of communication to all students in the initial years. In order to reach more students with greater frequency, additional steps have been taken.

The NP website now has a service-learning page that presents videos on service-learning modules and student testimonies. In addition, service-learning is covered by the deputy principal's presentation to prospective students and parents during NP's annual open house. Service-learning is included in NP's *Ultimate Course Guide*, and incoming students are also informed about service-learning in NP's *Student Life Booklet*. In addition, all students enrolled in a service-learning module watch a video and a slide presentation that cover what service-learning is at NP and what students can do to gain more from their community-based experiences. A student e-newsletter that highlights service-learning is published two to three times a year and distributed to all students. These steps reflect the importance of mechanisms to establish service-learning as part of the student culture on a campus through effective communications. Other institutions will need to creatively develop their own steps for ensuring that students understand that service-learning is a pervasive and expected part of the curriculum (National Task Force on Civic Learning and Democratic Engagement, 2012).

Phase 2 scaffolding of service-learning will offer students more opportunities to engage in service-learning projects of their choice, which can build upon the Phase 1 module projects. The Phase 2 projects can provide stronger ideation models, more sustainable partnerships, deeper solutioning considerations, broader scope, and more extensive reflection on their civic engagement. The various options of scaffolding (i.e., students taking a second module with service-learning, working on final year or capstone service-learning projects that address social issues, participating in a civic internship with organizations that help to promote public good, embarking on international service-learning programs, initiating cocurricular projects that address social issues) give students the opportunity to have a stronger voice and to develop their leadership potential. Thus, institutions can explore methods of expanding initial steps at institutionalization in educationally meaningful ways for students.

The effects of implementing institutionally pervasive service-learning modules for every student raise questions about students' attitudes and motives toward these requirements, as well as the nature of changes in attitude toward service-learning

and toward their short-term and long-term civic engagement that take place after one or more service-learning modules (Moely & Ilustre, 2018). Ascertaining the optimal way to design programs for students that influence lifelong habits of civic involvement is an important issue that warrants additional research.

Conclusion

After more than five decades of practice in the United States and a somewhat shorter history worldwide, service-learning has advanced civic engagement as an innovative way in which institutions of higher education can take steps to improve collaboration with community partners, contribute to the public good, enhance the curriculum and learning, and enhance students' civic learning as well as academic learning and personal growth. Institutionalizing service-learning is thus best viewed not as an end in itself but rather as a means for broader purposes.

The early institutional steps taken by NP are those activities that have been identified by research as key to successful institutionalization: alignment with mission, strategic planning, executive leadership, and infrastructure (e.g., Bringle & Hatcher, 1996, 2000; Morton & Troppe, 1996; Welch & Saltmarsh, 2013). Multiple forms of evidence support the conclusion that significant gains have been made for institutionalizing service-learning at NP. In addition to the evidence offered here, an external review by the Talloires Network awarded NP first place in 2020 with the MacJannet Prize, which recognizes exceptional student community engagement. What is also noteworthy is not only the rapid institutional advancement of service-learning but the Service-Learning Roadmap that extends the nature of institutionalizing service-learning in unique ways. We expect that the general steps taken at NP that have focused on the institution, instructors, students, and community partners will generalize to other institutions worldwide that aspire to go beyond individual service-learning prac-

titioners implementing service-learning courses and consider how service-learning can be institutionalized, but this warrants empirical validation. In any case, other institutions can be innovative in developing their own strategies for furthering service-learning, civic engagement, and the public purposes of their institutions.

Nonetheless, it must be acknowledged that the steps taken to date are early steps that warrant subsequent attention to all activities focused on integrating service-learning into NP's educational culture. Furthermore, as Bringle and Hatcher (1996) pointed out, the steps outlined in CAPSL and those already taken might be sequentially prioritized, but they are never completed: Activities need to circle back on all of these areas in a nonsequential manner, as needed (e.g., planning is an iterative and recurring process). A strong test of institutionalization is the capacity for the initiative to survive changes in leadership, staff, instructors, and community partners. Therefore, much subsequent work will need to be devoted to broadening and deepening service-learning among all constituencies (i.e., instructors, institution, students, community partners) and the relationships between and among them (Bringle & Clayton, 2013). This illustrates that institutionalization is not a final goal or end state, but a process of quality improvement.

As Holland and Furco (2004) noted, service-learning is best viewed as a facilitator of other campus goals rather than a standalone program. Therefore, part of the focus by other institutions should not only be on more and better service-learning, but also more broadly across campus (e.g., student affairs, alumni, quality assurance, hybrid pedagogies integrating service-learning with other teaching strategies). This remains the challenge for NP and for other higher education institutions around the world aspiring to institutionalize service-learning to educate students to contribute to the public good across their careers and lives.

Acknowledgments

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Faculty Perspectives on Coeducation and Reciprocity

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Abstract

The purpose of this study was to investigate faculty members' perspectives on coeducation and reciprocity within service-learning partnerships. Participants included 22 faculty members from a variety of disciplines at a midsized private university in the southeastern United States. Faculty identified communication as well as teaching and learning practices as the two tools needed for effective coeducation. Participants emphasized giving and receiving, communication, and clarifying expectations as key factors required for reciprocity. This study can help guide faculty members in fostering coeducation and achieving reciprocity in service-learning experiences.

Keywords: faculty, reciprocity, coeducation, service-learning

Research has shown that service-learning offers both benefits and challenges for college students, faculty, and community partners (Jacoby, 2015). A key element of effective service-learning practice is ongoing reciprocity in the partnerships between universities and community organizations (Jacoby, 2015). Thus, it is crucial to examine how such reciprocity is established and maintained, as well as to explore the related but less researched topic of coeducation.

The meaning of *reciprocity* can vary, and the term is often not adequately defined in the literature, unintentionally creating confusion. Resolving this confusion requires not only clearly defining this term in the context of service-learning (Dostilio et al., 2012) but also examining how faculty themselves define it. Moreover, the means for achieving reciprocity are often misunderstood (Sandy & Holland, 2006). Faculty and community partners must have a shared understanding of the meaning of reciprocity within the service-learning partnership if they are to cultivate and maintain a successful relationship (Sandy & Holland, 2006; Worrall, 2007).

Reciprocity occurs when faculty and community partners communicate ideas, take mutual responsibility, and pursue shared outcomes. Achieving reciprocity requires that members of the university aim to work *with* rather than *for* the community. Reciprocity is necessary to ensure that both the university—including faculty members—and the community will benefit from the service-learning relationship (Miron & Moely, 2006).

The need for reciprocity in service-learning differentiates this activity from other forms of volunteering, such as community service (Henry & Breyfogle, 2006). Henry and Breyfogle argued that given the centrality of reciprocity to service-learning, the provider–recipient model of service-learning needs to be rethought. Service-learning requires an enriched form of reciprocity that encompasses shared authority, flexible boundaries, and benefits for all parties. The belief that authority must be shared by faculty and community partners is highlighted by Blouin and Perry (2009), who asserted that enhancing the outcomes of service-learning for all parties requires sharing power and control.

George-Paschal et al. (2019) identified five themes that emerged from studying the overlap between the experiences of students, faculty members, and community

partners engaged in service-learning:

> the time-intensive nature of service-learning, the added value provided by the service-learning faculty member, the additional benefits created by service-learning connections, the unintended opportunities for discovery of self and others, and the impacts of the liminal space of service-learning transcending traditional academic boundaries. (p. 43)

Given that these themes are common to all stakeholders, they present key areas for consideration when determining the factors necessary for reciprocity and coeducation.

Looking at service-learning through a lens of reciprocity and shared responsibility supports a conception of faculty members and community partners as coeducators. Coeducation in service-learning involves sharing ideas in the pursuit of knowledge. Barreneche et al. (2018) explained that "coeducators explore the opportunities that exist to connect the course curriculum with areas of impact and need in the community" (p. 249). In the context of coeducation, learning occurs both inside and outside the classroom, and students may learn as much or even more from the community partner than from the professor (Darby et al., 2016). Because faculty members and community partners share the role of educators, if our goal is to create strong, effective teams of coeducators and to maximize the benefits of service-learning for universities and community organizations alike, it is vital to understand faculty members' perspectives on coeducation.

Cooper and Orrell (2016) explored how universities and communities interact with each other and provide students with the opportunity to obtain hands-on experience. Students gain valuable skills and exposure to a real-world environment through engagement in the community; as a result, they may be better prepared to take responsibility and be accountable for their actions when they enter the workforce. The learning that occurs both inside and outside the classroom as a result of the reciprocity and engagement between faculty and the community has a significant and lasting impact on students.

When faculty conceive of service-learning relationships in terms of doing work *for* community partners, they create a sense of distance and separation and establish a hierarchy in which the university holds the superior position. In contrast, faculty members who approach such partnerships with the mind-set of working *with* the community foster more equitable and mutually beneficial relationships. Although much of the focus in service-learning has emphasized its benefits for universities and their students, incorporating community perspectives is necessary to more fully understand how reciprocity and coeducation function in the context of service-learning (Ward & Wolf-Wendel, 2000).

Some researchers have questioned whether service-learning does, in fact, yield mutual benefits for universities and community partners (Hammersley, 2012). Because little research to date has examined the relationship between faculty and community partners engaged in service-learning, the present study takes the crucial step of exploring faculty perspectives. For service-learning to result in a successful partnership, it must be reenvisioned as a collaborative endeavor between faculty and community partners (Hammersley, 2012). The purpose of this study is to explore how faculty members define and understand reciprocity and their role as coeducators in the context of service-learning.

Methods

The participants in this study are faculty at a midsized liberal arts institution in the southeastern United States. After receiving IRB approval, the researchers used purposeful sampling to identify potential participants, drawing on a university database managed by the Center for Service-Learning to identify faculty in all four of the university's colleges who were engaged in service-learning. Of 30 possible respondents, 22 chose to participate, yielding a response rate of 73%.

The sample is representative of the faculty who teach service-learning at the university. Fifteen of the participants are female and seven are male. Two hold the rank of full professor, 12 are associate professors, five are assistant professors, and three are lecturers. Fourteen of the faculty are tenured, one is non-tenure track, three are on the tenure track, and three hold lecturer appointments. Additional demographics are presented in Tables 1–4.

Table 1. Faculty Demographics: Years Taught	
Years taught	Frequency
1–5	4
6–10	7
11–20	7
21–30	4

Table 2. Faculty Demographics: Number of Service–Learning Courses Taught	
Number of S–L courses	Frequency
1–2	14
3–5	8

Table 3. Faculty Demographics: Number of Service–Learning Course Sections Taught	
Number of S–L sections	Frequency
1–2	1
3–5	3
5+	18

Prospective participants received an email inviting them to participate in the study; if they did not respond to the email after a week, they were contacted by phone. Those who agreed to participate were interviewed in person, with interviews lasting on average 24 minutes, and all interviews were audio recorded. Faculty were asked to provide demographic information and respond to interview questions related to coeducation, such as "How do you define coeducator?" "How do you see yourself as a coeducator?" "Describe a time when you were a coeducator," and "What tools do you use as a coeducator?" Participants were also asked the following questions related to reciprocity: "How do you define reciprocity?" "Describe a time when you experienced reciprocity," and "What factors are necessary for reciprocity?"

Audio recordings were transcribed for analysis. Once we had compiled the participants' responses in a Word document, we conducted open coding, which involved identifying relevant excerpts in response to our analysis questions (Boeije, 2010). The following analysis questions guided the coding of each transcript.

- How do faculty define coeducation and what tools do they use as co-educators?

- How do faculty define reciprocity and what factors do they identify as necessary for reciprocity?

We then placed the codes in a table to identify patterns in the form of categories. A *category* is "a group or cluster used to sort parts of the data" (Boeije, 2010, p. 95). We created a visual display to help us examine the categories; this allowed us to see how the categories interacted, which led to the development of themes.

Findings

Four themes emerged from the findings in this study: defining coeducation, tools for coeducation, defining reciprocity, and factors for reciprocity. The definition of coeducation encompassed three categories: partnerships, methods of teaching and learning, and shared responsibility. Tools for coeducation likewise included three categories: communication, methods of teaching and learning, and discussion. Reciprocity was also defined through three categories: giving

Name	Gender	School/College	Rank	Years teaching	# of S–L courses	# of S–L sections
Tom	Male	Education and Wellness	Associate	6–10	3–5	5+
Beatrice	Female	Arts and Sciences	Professor	21–30	1–2	5+
James	Male	Communications	Associate	11–20	3–5	5+
Scott	Male	Education and Wellness	Associate	11–20	1–2	5+
Valerie	Female	Education and Wellness	Associate	11–20	3–5	5+
John	Male	Business	Associate	6–10	3–5	5+
Noah	Male	Communications	Associate	1–5	1–2	1–2
Megan	Female	Arts and Sciences	Assistant	6–10	1–2	5+
Charlotte	Female	Arts and Sciences	Lecturer	11–20	3–5	3–5
Katie	Female	Arts and Sciences	Assistant	1–5	1–2	5+
Olivia	Female	Business	Assistant	1–5	1–2	3–5
Marissa	Female	Arts and Sciences	Assistant	1–5	3–5	5+
Robert	Male	Arts and Sciences	Assistant	21–30	1–2	5+
Sophia	Female	Communications	Professor	6–10	1–2	5+
Jill	Female	Business	Associate	21–30	1–2	5+
Molly	Female	Arts and Sciences	Associate	21–30	3–5	5+
Cassie	Female	Arts and Sciences	Associate	11–20	3–5	5+
Robin	Female	Arts and Sciences	Associate	11–20	1–2	5+
Karen	Female	Arts and Sciences	Lecturer	11–20	1–2	5+
Ryan	Male	Communications	Lecturer	6–10	1–2	3–5
Emma	Female	Arts and Sciences	Associate	6–10	1–2	5+
Jessica	Female	Communications	Associate	6–10	1–2	5+

Table 4. Faculty Demographics

and receiving, mutual benefits, and equal exchange. Finally, factors for reciprocity incorporated two categories: communication and expectations. The following section illustrates these findings with quotes from participants.

Defining Coeducation

Partnerships

When asked to define coeducation, 12 participants offered definitions that emphasized partnerships. In the context of service-learning, partnerships may occur between faculty and community partners as well as among faculty, students, and community partners. Molly, who has over 21 years of teaching experience and has taught more than five sections of service-learning courses, explained,

> To me being a coeducator means that I'm not just trying to meet the needs of my students' learning outcomes, but I'm also trying to partner with my agency and trying to help meet their needs as well. That's part of teaching students, is what the community partner needs and engaging her fully in that process. So she's here at the beginning teaching them how to do it, and then she goes to probably three-quarters of the sessions that they facilitate at the schools and I go to the other ones. So we are in partnership to make that happen

because we don't send the students anywhere without one of us being there.

Molly highlights the challenges associated with balancing the needs of her students with those of the community partner. An important part of her partnership with the community agency is having a coeducator present whenever students are engaged in service-learning.

Collaboration is crucial to the work between faculty and community partners. In her definition of coeducation, Jill, who has over 21 years of teaching experience and has taught more than five service-learning sections, observed,

> The first thing that comes to mind is the collaboration, the collaborative piece, is. . . the importance of getting to know the partner ahead of time and meeting with them. And if I can go into their organization or their business first, so that we can sort of plan out what it is that my students need to get from the collaboration and what they need to get from the collaboration.

Jill emphasizes the benefits of getting to know the community partner before the service-learning class begins. This preparation allows the two entities to organize and plan out the course in advance, increasing their likelihood of achieving the goals of both parties.

The university and community must work together in a partnership for coeducation to be successful. By establishing a partnership between those responsible for experiences both inside and outside the classroom, authentic learning can occur.

Methods of Teaching and Learning

Eight participants identified teaching and learning methods as an important component of the definition of coeducation. This category bridges a variety of educational perspectives on improving teaching and learning experiences. The ability to make connections between their education in the classroom and in the field represents one of the greatest benefits of service-learning for students. Students who are engaged in community organizations can apply the knowledge obtained from those experiences to the content they learn in the classroom

and vice versa.

Cassie, who has taught more than five sections of service-learning in over 11 years of teaching, explained,

> Inevitably [students] talk about their fieldwork as the most pivotal learning moments for them; that that's when they really got a sense of, "All right, this is what this field is like. This is what it feels like." And they are able to make those connections. "Oh yeah, I remember reading about this in my social policy class. I remember reading that you've got to do a needs assessment before you can start to put all the pieces together. We're doing a needs assessment at my agency." That sort of thing. So one can't succeed without the other.

Faculty and community partners need to reach an agreement about the intended learning outcomes for students in a given service-learning context. This agreement can be formal or informal, but it should be intentional and explicit. Emma, who has taught 6–10 years and 5 or more sections of service-learning courses, noted that effective service-learning requires the engagement of "two people that come together from different fields or different perspectives, perhaps, that are working together for a common educational goal or a common learning objective."

Shared Responsibility

Six participants emphasized the importance of shared responsibility when defining coeducation. Shared responsibility occurs when two or more people take ownership of common goals and outcomes. Tom has been teaching for over 6 years and has taught more than five sections of service-learning courses. His response to the question of how to define coeducation was direct and concise: "Shared responsibilities for educating, and that's a simple definition."

Megan, who has been teaching for more than 6 years and has taught more than five service-learning sections, expanded on this theme:

> It builds in some of the basic notions about service-learning. So coeducation with community partners, for me, is not a one-way

thing. So we're doing for the part-ners, but they define what are the priorities, what are the things they want students to do. Some commu-nity partners have a clear idea about "this is what you're going to do," but there are still choices within that relationship with the students.

Participants also emphasized the impor-tance of viewing the various relationships between faculty, students, and community partners as partnerships. Teaching and learning provide the framework within which all three parties design course ob-jectives, achieve goals, and connect course material to real-world experience. Shared responsibility in coeducation involves fac-ulty and community partners taking on complementary and cooperative roles in the service-learning experience.

Tools for Coeducation

When asked to identify the tools that must be present for coeducation to occur, partici-pants most commonly referenced commu-nication, specifically communication with a community partner outside the classroom setting. Teaching and learning methods, in particular the use of observation and reflec-tion in the classroom, was the second most identified category. Finally, participants also highlighted discussion as a tool they incorporate in the classroom to promote coeducation.

Communication

Twelve faculty members raised the issue of communication in reflecting on the tools needed for effective coeducation. Katie, who has taught for more than one year and has taught more than five service-learning sec-tions, emphasized the importance of main-taining ongoing and open communication with her community partner:

So a tool I use, I would say, is consistent communication. So I really try to be in communication and connected with coeducators across the year in different ways. And so Practicum is a course that I'm constantly putting students out into organizations. But for the local organizations in particular I try to make sure that that's not the only time I'm communicating with people, that it's not just about this

class, but it's about, like, How do we make connections in other ways, or what support can I offer to you as a faculty member? Is there some continuing, an education opportu-nity, or do you need a connection here? Or do you need student vol-unteers for this event? Or how can we work together kind of in a more continual way? So that's one tool, is communication.

John, who has taught more than five ser-vice-learning sections in over 6 years of teaching, also highlighted the need for all stakeholders to establish a foundation for effective communication and agree on ex-pectations to achieve genuine coeducation:

I start off every semester with a meeting between the client, myself, and the students. We can share at all levels, set expectations on what they get out of it, what the stu-dents need from the client in order to complete their project—which sometimes can be a challenge—and then what they're going to deliver to the client, to make sure they un-derstand what to expect.

Methods of Teaching and Learning

Within the category of teaching and learn-ing, participants described their use of methods such as reflection and observa-tion in their pedagogical approaches to service-learning. Olivia, who has taught for over one year and has taught three to five service-learning sections, explained the importance of

having the students engage in re-flective writing and pulling themes out of it, and then having some open discussions. And students raise questions and reflection, [we] bring them out for the whole class [to discuss], we do a lot. We also, in trying to think about defining problems and solutions, use some of the design thinking framework.

And so I'm trying to first empathize with people who are different from yourself to really understand what the problem is, and how to then— and then go very broad and thinking about solutions that you might pro-pose to a partner. So that you're not

just giving them one option to vote up or vote down, but really you're giving them a breadth of solutions and then listening and empathizing again, to hear their responses to it. To try it and create and iterate until you can work with that partner to create something of value.

Reflection as a tool enables students to analyze the relationships they establish with community partners and their constituents and illuminate the benefits of those relationships.

Incorporating the voices of community partners is critical in service-learning, and Charlotte accomplishes this by observing students herself and inviting community partners to offer observation-based feedback as well. Charlotte, who has taught three to five service-learning sections in over 11 years of teaching, explained,

> I like for [community partners] to do some sort of evaluation at the end. Let the people who are involved tell them what they think about what they did. And I guess that's a tool of sorts. And then I do like observing them in action. So if that's a tool, that observation is something that I like to do. And I generally do ask the partners to comment as well. I use that information as an instructor. I don't necessarily make it impact their grades so much, as so that they know what their strengths were or what the partner thought that the strengths were. So I share that with the students anyway.

Incorporating observation from both faculty and community partners in this way strengthens the students' learning process.

Discussion

Discussion in and out of the classroom and the use of multiple forms of technology represent important tools for coeducation. The approaches that faculty use vary, but many seek to relate classroom learning to students' experiences at the service-learning site through discussion. Other forms of discussion come through the use of technology, such as meeting with community partners via Zoom.

Cassie has taught more than five service-

learning sections in over 11 years of teaching. She reported utilizing both large and small group discussions to connect in-class learning to the service-learning site.

> So I facilitate a lot of discussions, and I like to start in the small groups. I'll usually give some sort of writing prompt and then I'll get students together and say, "Talk about what you wrote about that you're comfortable sharing." And then I run around, I call it the hummingbird. I flit from group to group, and then we do large group processing: "All right, let's share some of the highlights." And the prompt is usually around a particular concept that they're having to apply to the service-learning site or activity or a particular idea or comparison.

Scott, who has taught more than five service-learning sections in over 11 years of teaching, described incorporating multiple discussion formats that vary from in-person conversation to interacting through various forms of technology. Such discussions can help all parties identify goals and determine what needs to be done in the service-learning relationship.

> I think obviously discussion, but you have to . . . I feel like it helps to be able to articulate, What are your goals and outcomes? What do you want to have happen? So there's a lot of different ways to do that. I think that technology is one tool for that, but it all has to be done in collaboration through discussion. So I'm not sure how to apply tools and methods. I know some people do like surveys of sorts with the community partner, sort of identify needs. I tend to be more someone who likes to be present with them and be in the space and on the ground and listening and then try to infer, okay, this is what I hear, this is what I see, this is what I notice.

Participants identified communication, teaching and learning methods, and discussion as the primary tools necessary for coeducation. Communication focuses on students and faculty interacting effectively with community partners, whereas teach-

ing and learning methods encompass approaches such as reflection and observation. Discussion is a tool that may be utilized with students in the classroom as well as with community partners in other settings or via technology. These tools are indispensable in facilitating coeducation and deepening understanding among all parties.

Defining Reciprocity

Giving and Receiving

When asked to define reciprocity, a majority of participants (13 out of 22) emphasized the importance of giving and receiving. Marissa, who has taught for over one year and has taught more than five sections of service-learning courses, defined reciprocity as "the relatively equal give and take between collaborating members of some—whatever—just an equal give and take between people who have a vested interest in something." Similarly, Karen, who has taught more than five service-learning sections in over 11 years of teaching, focused her definition on "give and take. What the students can do for [the organization] and then what [the organization] can do for our students. I see it as a give and take." These participants recognized the necessity of maintaining a two-way relationship between the university and the community partner.

Mutual Benefits

Six participants referenced mutual benefits when defining reciprocity. Jill, who has taught more than five service-learning sections in over 21 years of teaching, explained how empirical knowledge is gained from the collective experiences of all parties.

> I gain from my experience with you, you gain from your experience with me. I don't want to say one hand washing the other, but maybe the pieces kind of coming together in a reciprocal relationship, where both people benefit, both people learn, both people grow from it.

Noah, who has taught for over one year and has taught one to two service-learning sections, also highlighted the benefits of reciprocal relationships in his definition. He noted, "So I would say a dictionary definition of reciprocity would be the outcomes, the benefits, the deliverables for all the parties in a relationship, the sum of those."

Equal Exchange

In defining reciprocity, six participants spelled out the factors that make up an equal exchange. When engaging in a reciprocal relationship, Ryan, who has taught three to five service-learning sections in over 6 years of teaching, emphasized that "equal contributions and justness and fairness of behaviors and actions" are essential. Expanding on the idea that an equal exchange is necessary for reciprocity to take place, Charlotte, who has taught three to five sections of service-learning in over 11 years of teaching, also referenced issues of justness and fairness within the relationship, stating,

> I think that it's a win-win situation. That there's an exchange, an equal exchange or some sort of exchange that takes place from that relationship. It's a give and a take. Not all one-sided. Yeah. And I want students to give, certainly, to meet a need. But I also want them to have learned something. And I think in a way that's getting something by learning something.

These three categories highlight how balanced two-way relationships between the university and community partners can promote both equitable contributions to the service-learning experience and an equal exchange of benefits and value.

Factors for Reciprocity

The participants highlighted communication and the clarification of expectations as the two most important factors for reciprocity. An important criterion for achieving reciprocity is a willingness to be part of the experience, knowing that the answers may initially be unclear and may need to be discovered over time.

Communication

Ten participants identified communication as an essential component of reciprocity. Clear communication helps improve both parties' understanding of one another within the service-learning relationship. Robin, who has taught more than five sections of service-learning courses in over 11 years of teaching, emphasized the importance of

> the willingness of both parties to

engage and explore the space of interaction. But somebody has to propose that introduction. And once you have the proposal, then you need to have an honest discussion. Okay, what good is this for you? What good is this for me? I think having very good communication with your partner is the essential first step. If you don't have that you're setting up yourself for mis-understandings. That's important.

What's also, I think, important is not forcing the partnership. If you realize that your partner is look-ing for something that's not going to match with what you can offer, then it's better not to engage. It's better to walk away and say, well, this is just not right as a partner-ship. Because I would be doing a disservice, then the relationship can be one-sided and that's not correct.

I think, yeah, communication. Being very honest about expecta-tions and not being transactional, because in many cases our partners are not looking just for a one-off. They are looking for an expanded space of collaboration. And if it's something that we cannot provide, then we cannot work with them. That's not right.

Robin highlighted the importance of open communication at the beginning of the partnership to clarify roles and expecta-tions, noting that this early dialogue is critical for accomplishing shared goals.

Valerie, who has taught more than five service-learning sections in over 11 years of teaching, offered additional insight into the verbal and nonverbal communication needed to fully engage with others:

Open mind, open heart, willingness to work, willingness to admit errors and make mistakes, try again. [I] talked about humility before, will-ingness to be humble, willingness to listen, to be the learner rather than the expert, willingness to see the beauty in the families and the children that they're working with and take that as their guide.

Expectations

Seven participants noted the importance of expectations when describing the factors needed for reciprocity. Sophia, who has taught more than five service-learning sec-tions in over 6 years of teaching, outlined the key role of

Well, expectations. Setting up ex-pectations at the beginning, and sometimes I think that's where the partnerships fail. That it's not clear that yeah, if this student isn't con-tacting you once a week or checking in or sending you content to review, then they're not really engaging in the level of relationship that we want.

So I think setting up expectations at the beginning of this is what I'm expecting of my students. They're supposed to log a time sheet to show the value of what they're working on. Also, they're supposed to make a certain minimum number of contact hours with the actual client, and that, I think, enhances that experience. Then also just re-quiring them to go in person if it's an organization that is local, that they need to have that in-person contact to be involved on site.

Cassie, who has taught more than five service-learning sections in over 11 years of teaching, highlighted the need for all par-ties in the relationship to understand one another's expectations. She reflected,

So there has to be mutual under-standing of what the expectations are. The reason my partnership with [the organization] works so well is because it's been going on long enough to where people know, "Oh, you're from [class name]. You're going to bring [materials]. You're going to need to have one-on-one time. . . ." And then the students have to understand, "All right, time doesn't stop when you arrive there."

So there just has to be, the expecta-tions have to be clear. This is why you're here. This is who you're reporting to. This is what you're going to do while you're there. And on the other side, this is who this

young person is. This is what this young person's here to do. And this is what it will look like. Just clear communication on both sides about what's going to be happening.

Discussing the student's role and responsibilities at the beginning of each session in this way lays the foundation for reciprocity to occur.

Communication and clarifying expectations underpin a successful service–learning experience. These factors require faculty members and community partners to sit down together and discuss their roles and responsibilities. By being forthright and clear with one another, faculty members and community partners foster and maintain reciprocity.

These categories illuminate the critical role of open communication in establishing and maintaining a strong relationship between faculty and community partners. A key element of this relationship involves giving and receiving, as well as the belief that this relationship can yield an equal exchange.

Discussion

Faculty view coeducation and reciprocity as necessary components that work hand in hand to create successful community partnerships. Employing teaching and learning methods both inside and outside the classroom is critical to coeducation. Effective communication emerged as a foundational component of both coeducation and reciprocity. Faculty report that giving and receiving in an equal exchange with community partners is key to fostering successful and lasting relationships.

Similar to previous research (Henry & Breyfogle, 2006; Miron & Moely, 2006), in this study faculty stressed the benefits that result from the service–learning relationship. Blouin and Perry (2009) and Henry and Breyfogle (2006) identified the importance of shared power in partnerships between faculty and community organizations. This finding was echoed in this study in relation to equal exchange and shared responsibility. As illuminated in previous research and again in this analysis, effective reciprocity requires frequent and clear communication (Sandy & Holland, 2006; Worrall, 2007).

Unique to this study, communication was found to be an important tool for coeduca-

tion, as well as reciprocity. In exchanges between faculty members and community partners, faculty noted, the expectations of both sides must be articulated and understood. Methods of teaching and learning, such as reflection and observation, were also highlighted as fundamental tools of coeducation.

Incorporating various forms of discussion can enhance students' understanding of the course content as well as the service–learning experience. Although previous research has discussed partnerships, it has not described the finer details of these relationships and the need for faculty and community partners to work together within a coeducation framework. The most frequently cited category, giving and receiving, illustrates the two-directional approach that is critical for genuine reciprocity.

The limitations of this study are based primarily on its demographics. All participants were from the same midsized liberal arts institution in the Southeast, and the sample size of 22 faculty members was relatively small and predominantly female. The majority of participants held an assistant or associate professor rank, with the exception of two full professors and three lecturers.

In addition, a majority of the faculty had considerable experience with service–learning, having taught more than five sections of a service–learning course. Prospective participants were identified through a database managed by the university's service–learning center, which could have influenced the participant demographics. Finally, the interviewer served as a faculty fellow for service–learning at the university, which could have influenced participants' responses. As a result of these factors, the results of the study are not generalizable to a broader population.

Implications

This study helps pinpoint the necessary components for developing strong service–learning partnerships based in a coeducational and reciprocal context. It recognizes the high value faculty place on elements such as giving and receiving, communication, clarifying expectations, teaching and learning methods, shared responsibility, partnerships, discussion, mutual benefits, and equal exchange. These qualities as described by faculty are essential to creating

authentic partnerships.

This data offers guidance for faculty seeking to establish and sustain meaningful relationships with the community organizations with whom they partner. Working *with* the community and not *for* it is part of how faculty can ensure a coeducational and reciprocal experience that fosters student engagement. More specifically, communication is essential prior to and throughout the experience; it is necessary for ongoing assessment and to ensure that mutual goals are achieved. In addition, incorporating various methods of teaching and learning both inside and outside the classroom is necessary to prepare students to apply their on-site experiences to content taught in the classroom and vice versa.

Areas for future research include exploring the connection and overlap between faculty and community partners' perspectives on coeducation and reciprocity, as well as investigating students' perceptions of these key terms. Further research on specific approaches to achieving reciprocity would also be valuable. Although this study did not answer the question "Can reciprocity and coeducation exist separately?" future research should examine the relationship of these practices to one another. Finally, power differentials in relationships between faculty and community partners need to be explored to determine how these two parties can create an equal exchange. For example, future research should examine how reciprocity and coeducation may be influenced by race and gender.

Conclusion

The present study is intended to help guide early- and midcareer service-learning faculty and to support their planning from initial course design through the teaching of the course to the end-of-course assessment. Although this study examined faculty members' perspectives, it is equally important to acknowledge the community partners' role as coeducators responsible for maintaining the reciprocal nature of the partnership. Moreover, students also need to understand the complexity of these relationships. To be thoughtfully engaged with the community requires active and intentional efforts that contribute to teaching and learning and create meaningful experiences for students. As faculty teach more sections of service-learning courses and increase their experience and knowledge, they will continue to revise and deepen their understanding of their roles as coeducators in reciprocal partnerships.

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Characterizing STEM Community-Based Learning Through the Interstakeholder Dynamics Within a Three-tiered Model

David A. Delaine

Abstract

Community-Based Learning (CBL) within science, technology, engineering, and mathematics (STEM) has the potential for positive student learning outcomes while also promoting beneficial outcomes in partner communities, yet complexity of practice can often obscure or limit these outcomes. Emergent behavior makes realizing outcomes, especially those for the community, difficult. A systems-level approach can minimize some complexity, yet empirical evidence of how STEM CBL is structured is limited. A three-tiered model (i.e., Community, Program, and Individual levels) is used as a structural framework to analyze two case studies to answer: How do three system levels describe the STEM CBL practitioners, their actions, and goals? Thematic analysis of data generated through participant-observation within two purposefully selected cases establishes a foundation for how these system levels can impact practice. Distribution of effort across the three levels can support well-rounded CBL practice and advance the voices of all practitioners, but especially those with less power.

Keywords: community-based learning, interstakeholder dynamics, STEM

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Community-based learning (CBL), a pedagogical approach in which local communities participate as partners in learning (Mooney & Edwards, 2001), shows substantial value in educating developing science, technology, engineering, and mathematics (STEM) professionals while supporting broader societal outcomes such as STEM literacy, workforce development, and the design and implementation of solutions. Within STEM disciplines, CBL is most commonly implemented as service-learning, outreach, and volunteerism (Johri & Olds, 2014). CBL differs from other pedagogies through its community-based context and its potential for local impact, where in theory, benefits can manifest for all participating practitioners and stakeholder categories. In underserved communities, CBL has the potential to support social justice (Mitchell, 2008; Nieusma & Riley, 2010) and broaden participation (Young et al., 2017). At the university, CBL can support college students' development of critically needed professional skills in engineering, such as leadership, empathy, and citizenship, as well as teaching engineers to grapple with "wicked problems" while leveraging globalization for positive outcomes (Bielefeldt & Canney, 2014; Delaine et al., 2015).

Despite the potential for positive and transformational outcomes, CBL often fails to reach its theoretical potential (Baum, 2000) and can have unintended negative outcomes. For example, in contexts where students are charged with creating solutions for local challenges, without careful training, students engaging in CBL can reinforce stereotypes or deliver unnecessary, inappropriate, and expensive solutions (Mitchell et al., 2012). Therefore, university-based CBL practitioners must be careful to respect community partners and minimize harm while pursuing positive outcomes. University stakeholders in CBL partnerships may find it difficult to maintain this balance because they often hold more influence. It is

broadly recognized that reciprocity, or "the relationships between the 'service providers' and 'service receivers' and the mutuality between their needs and outcomes" (Henry & Breyfogle, 2006, p. 27), should be a goal of any CBL effort. Without emphasis on reciprocity, there is a greater potential for negative repercussions for the stakeholders; however, the dynamics of CBL reciprocity in STEM contexts are poorly understood. Therefore, further knowledge is needed to support such reciprocal implementation of STEM CBL to protect community partners, produce positive community outcomes, and promote social justice.

The purpose of this research is to provide a cohesive overview of STEM CBL practice through a synthesis across two case studies. This research results in a model that describes STEM CBL using three system levels—community, program, and individual—as proposed by the National Research Council (NRC) for informal STEM learning (NRC, 2015). This study empirically investigates two purposefully selected STEM CBL efforts that originated from a single university. After situating this work in the literature, the case study research methods employed are described. A thematic analysis of participant–observation data within the selected cases establishes a foundation for how the system levels are manifested in practice. Three levels are used to describe the interstakeholder dynamics of STEM CBL practitioners and their actions and goals. This research can further knowledge of STEM CBL through advancing structural understanding within the complexity of practice to promote well-rounded approaches to CBL participation and the dynamics between stakeholders toward positive and reciprocal university and community outcomes.

Literature Review

Community-based learning is distinct from other pedagogies in its use of community contexts and settings outside the university and the pursuit of nonuniversity outcomes. As higher education is increasingly called upon to deliver public good, CBL pedagogies have proliferated (Dostilio, 2017). Furco (2003) included service–learning, outreach, and volunteerism, as well as field education and internship, within a spectrum of pedagogies for community-engaged education. Swan et al. (2014) adopted this spectrum for use within an engineering context.

Unifying these pedagogies under a CBL umbrella provides for a holistic examination of their impact rather than placing emphasis on the specific implementation of each pedagogy independently. Holistic approaches can center the implications of partnerships upon which they are based and the outcomes produced by CBL, as well as support the systematic advancement of CBL through attention to the structures and dynamics of partnerships, by highlighting misalignments in practitioner actions and revealing the impacts on stakeholder groups and the intended CBL beneficiaries. Recent research on CBL within STEM contexts has predominantly focused on single pedagogical approaches, such as service–learning (Garcia et al., 2013; Oakes et al., 2014), outreach (Jeffers et al., 2004; Sadler et al., 2018), or volunteerism (Baytiyeh & Naja, 2014), leaving this unified CBL approach underexplored.

CBL can be implemented in various ways. Approaches can be centered on university or student outcomes through experiential education (Chan, 2012; Mooney & Edwards, 2001); reciprocal and integrated outcomes can be pursued across stakeholders and beneficiaries (Gilbert et al., 2015; Henry & Breyfogle, 2006; Weerts & Sandmann, 2008); or implementation can center community needs through democratic, participatory, or critical approaches (Crabtree, 2008; Dostilio, 2014; Miller, 2008). The approach and its implementation can strongly impact the outcomes and the extent to which they are negative or positive. Negative outcomes, including reinforcement of stereotypes and social hierarchy, have been reported, whereas positive outcomes can include social justice and institutional change (Chupp & Joseph, 2010).

The community engagement literature is in agreement that grounding CBL initiatives in partnership is critical. Consequently, a rich discussion on the characteristics of university–community partnerships has emerged (Drahota et al., 2016; Suarez–Balcazar et al., 2005). It has been shown that partnerships that embody shared values are more likely to minimize harmful impacts and support reciprocity within community and university outcomes (Dostilio, 2017; Drahota et al., 2016). Bartel et al. (2019), in a review of the ways university–community partnerships function, recognized three themes across prior investigations: (1) focus on how well partnerships work and factors

that lead to success, (2) examination of the ways partnerships fail and what factors are connected to these failures, and (3) previous and new models of structuring partnerships in an effort to strengthen drivers of successful partnerships and to promote Themes 1 and 2. Strier (2010) found several crucial factors to be acknowledged in the process of partnership management: role perspectives, group affiliation, institutional context, power relations, the organizational culture of the partnership, and the societal perceptions of social problems addressed by the partnership. Broadly, communication, respect, and trust across practitioners are understood to be critical to CBL partnership (Bartel et al., 2019; Mitchell, 2008; Suarez-Balcazar et al., 2005), as are mutuality, supportive leadership, and university immersion and asset building (Taylor et al., 2004). Multiple factors have been shown to inhibit CBL partnership, including power dynamics, cultural norms, and communication (Maurrasse, 2002).

Relationships across CBL stakeholder groups establish social networks that consist of a series of interpersonal relationships (Bringle & Hatcher, 2002) within which cultural differences add to the complexity of interactions (Bender, 1993; Bringle & Hatcher, 2002). Additionally, CBL partnerships are highly affected by structural forces, organizational cultures, and local contexts (Strier, 2010). Structural factors, including the type of university, mission, and institutional capacity, as well as the challenges faced by the partners and intended beneficiaries, have been shown to be impactful (Holland & Gelmon, 1998). Collectively, these factors contribute to the complexity of CBL in practice (Bringle & Hatcher, 2002; Strier, 2010). Due to these factors, frameworks that support understanding the dynamics of these partnerships can support the advancement of CBL to further knowledge of the ways in which the partnerships and the structures within CBL impact practice and the resulting outcomes.

In STEM fields, CBL initiatives have shown the potential to promote positive outcomes such as promoting STEM literacy and providing engineering solutions to communities in need (Bielefeldt et al., 2010; Oakes et al., 2014). Student outcomes often include strengthened professional skills, hands-on abilities, cultural competence, academic and life skill development, and sense of civic/social responsibility (Astin & Sax,

1998; Bielefeldt et al., 2010). Community outcomes include volunteers and sources of human capital, STEM solutions within the community's areas of need, and educational programming (Baillie, 2006; Leydens & Lucena, 2014; Nieusma & Riley, 2010). However, without careful management of these partnerships, unintended negative consequences can emerge, such as reinforcing negative stereotypes across stakeholder groups or the development of projects not useful to community partners (Nieusma & Riley, 2010).

These factors point to a need to investigate the dynamics of partnership within a STEM context. With CBL proliferating in the STEM fields and increased funding and attention being directed at STEM education, it is important to investigate CBL within this specific context. Several noteworthy STEM-based models characterize community engagement. Thompson and Jesiek's (2017) transactional, cooperative, and communal (TCC) model for service-learning in engineering includes three types of partnership: (1) transactional, where distinct boundaries exist between partners; (2) cooperative, in which some partners intentionally work together; and (3) communal, where deeper partnerships are grounded through common values. In another study, Eilam et al. (2016) presented a conceptual model for STEM outreach within university operations that highlights distinctions between "top-down" (led through university governance) and "bottom-up" (grassroots) efforts as essential to STEM outreach. Recently, researchers have investigated a single CBL system leveraging a holistic approach through qualitative research on the dynamics between differing stakeholder groups (Delaine et al., 2015; Delaine et al., 2019). Although recent efforts within STEM have increasingly called for reciprocity and community-oriented outcomes (Baillie, 2006; Nieusma & Riley, 2010), much work is still to be done to further the impact of emergent research on community engagement within STEM contexts.

In summary, a number of researchers have offered suggestions for how to improve university-community partnerships. These efforts provide substantial grounding for the dynamics within CBL partnerships and ways to improve these partnerships, yet investigations situated within engineering or STEM disciplines remain underexplored. Although prior studies have leveraged a systems-level

approach to CBL, structural models for CBL based on empirical evidence, grounded in theory, and that take a sufficient systems–level perspective are limited (Strier, 2010). Few studies leverage a unified approach to CBL within STEM contexts to clarify some of the complexities of CBL partnerships in practice (Delaine et al., 2015; Delaine et al., 2019). Non–STEM literature offers worthy suggestions, such as developing a shared a commitment, building mutual relationships, and supporting members of the community, but few studies investigate how such practice is structured (Mitchell, 2008; Rosenberger, 2014) or examine these principles at play in actual partnerships (Bartel et al., 2019). Further research is needed regarding the "broader system in which these relationships between universities and communities exist as well as opportunities for enhanced sustainability" (Barnes et al., 2009, p. 17), especially with a focus on how these dynamics intersect with structures of STEM CBL practice.

Theoretical Framework: Community, Program, and Individual Levels

The National Research Council (2015) de–scribes informal STEM learning environ–ments using the holistic concept of a "STEM learning ecosystem," a term referring to all the STEM assets in a student's community. As shown within the context of informal STEM education, a host of factors impact learning and engagement: setting (both designed and naturalistic), people and networks of people, and everyday encounters with STEM (NRC, 2015). Others have employed three–tiered models to analyze various forms of CBL (Chupp & Joseph, 2010; Mulroy, 2004). The NRC suggests a three–tiered approach to evaluating in–formal STEM ecosystems, recognizing the separation between individual outcomes, program–level outcomes, and community– or ecosystem–level outcomes, as shown in Figure 1. It is suggested that this approach can support understanding how informal learning affects outcomes across settings and time. In the present study, this frame–work is leveraged to investigate the impacts of these levels across STEM CBL partner–ships in practice. Although there has been research on independent levels (Bringle & Hatcher, 2002; Mulroy, 2004) and at a system level (Head, 2007; McNall et al., 2015), efforts that integrate understand–
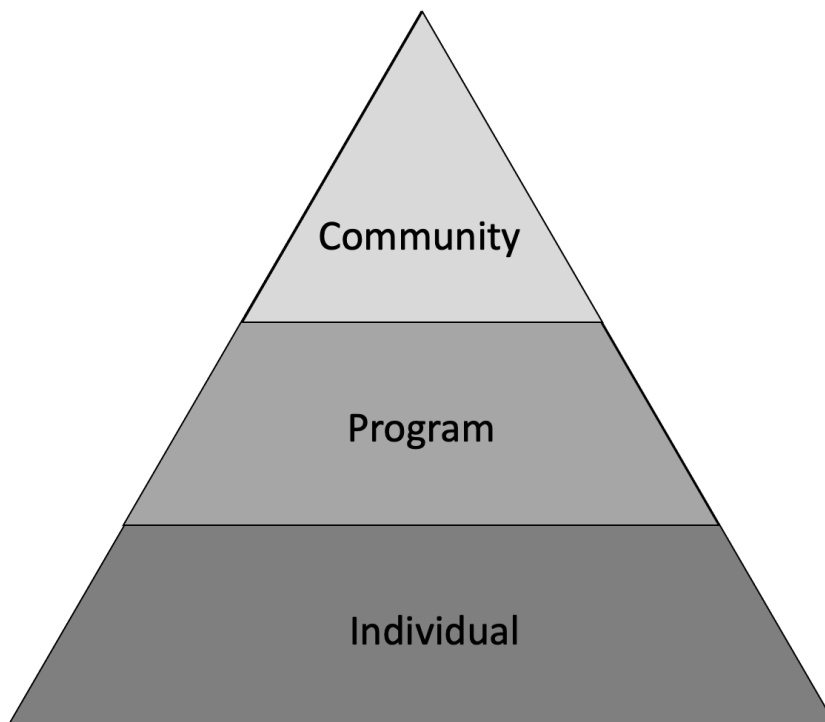

Figure 1. Three–level Framework

ing of partnerships or actions taken across these levels are limited.

In this research, the word *landscape* is preferred to *ecosystem* (as used by the NRC), due to the limited cohesion exhibited across the stakeholder groups within the investigated context. Prior investigations into community outreach have suggested that "a fragile outreach landscape, [that is] highly diverse, operating in a perpetual 'start–stop' model and mostly lacking institutional ownership" exists (Eilam et al., 2016, p. 421). Similar disconnected behaviors were exhibited within the CBL cases studied, and as a result, terminology implying a high level of interconnectivity (i.e., ecosystem) does not accurately describe the context studied.

Leveraging the three-tiered NRC system structure as an overarching framework, this work seeks to present an exploratory model that describes CBL practitioners, their interactions, and their goals across these levels. By understanding the implications that levels may have on the who, how, and why of CBL, this work furthers knowledge in the STEM CBL context to improve research and practice. The investigation presented answers the following research question: How do the three system levels (community, program, and individual) describe the STEM CBL practitioners, their actions, and their goals?

Method

This research used a case study method (Creswell, 2013; Yin, 2017) to focus on the characteristics of STEM CBL initiatives. Case study methods can retain the holistic and meaningful characteristics of the research context while providing insight into small group behaviors and organizational and managerial processes within their natural settings (Yin, 2017). In this work, the two STEM CBL efforts from within a single university were purposefully selected for an in-depth exploration of the context within a multicase study structure. In each case, multiple sources of evidence were captured to investigate the research question. Pseudonyms of both institutions and individuals are used for confidentiality, and all research has been conducted under IRB human subjects approval.

Empirical STEM CBL Context

The host institution, "Universidade Brasil Estadual" (UBE), in which the study originates, is a public university for high-achieving students in Brazil. It is a comprehensive university with a rich history, situated on a beautiful campus in a large city. For context, in Brazil, public universities are considered more prestigious than private universities, and are free for students who are able to gain admission through standardized testing. These placement exams are highly competitive, and only a small fraction of the student population is admitted. UBE is a comprehensive research university with several colleges and multiple degree-granting programs at both undergraduate and graduate levels.

Various STEM CBL activities exist within the local geographic region of the university. These include precollege research fairs and competitions (regional, national, and international), cocurricular service-learning and outreach, credit-bearing service-learning, volunteerism, and research internships within university laboratories. Some CBL initiatives within the landscape were shown to have limited or no affiliation with the university, whereas others were implemented in partnership with the College of Engineering at UBE.

Despite plentiful CBL activities, the culture of UBE is inclined toward academic excellence and research rather than community-based or socially oriented efforts. The institution maintains a university-wide administrative office that oversees and tracks what it calls "extension" activities that involve the broader public, yet only a small number of faculty, staff, and students maintain and implement these efforts. As a result, the individuals active in CBL often have strong networks and are well-respected among the students but are overburdened and carry multiple competing responsibilities.

Among the STEM CBL initiatives present within the investigated landscape, two initiatives were selected for case study analysis in a multiple-case design to support the study's robustness (Yin, 2017). The criteria used to select the CBL initiatives for case study included (a) the ability to obtain deep access into the efforts, (b) the alignment of the efforts with the host university, (c) maturity and scope of work, and (d) the extent to which the initiatives are aligned with community need and socially oriented outcomes, teaching, and learning. The cases selected for this research were (1) the

STEM Pre-College Research Fair, and (2) the Technical Citizen Collaborative.

Data Collection

This empirical study was conducted from April 2014 through April 2016 through participant observation (Glesne, 2016). Qualitative observations, through field and descriptive notes (Glesne 2016; McCall & Simmons, 1969), were collected for insight into interpersonal behaviors and motives (Yin, 2017). Observations were conducted by the author as a full participant (Glesne, 2016) from within various roles with each CBL case. These roles included participation in meetings/committees, serving as a judge/evaluator, supporting the development and implementation of the CBL efforts, and interacting with practitioners and beneficiaries from within the CBL activities. Throughout the research the author maintained daily research logs that captured thoughts, reflections, and observations of each case (Glesne, 2016). Meeting minutes were captured during formal meetings both from the author's notes and through formal meeting minutes captured by practitioners involved with the meetings. Documents were obtained from each case that include but are not limited to meeting agendas, promotional materials, email, and other communications.

Data Analysis

Data were qualitatively analyzed using NVivo software (Richards, 2014) to facilitate an iterative thematic analysis process and ensure consistency of the emerging interpretations from the data. Thematic analysis provides a flexible research tool that supports rich and detailed accounts through the analysis and reporting of patterns within data (Braun & Clarke, 2006). Initial topic coding of the transcribed data was performed in a deductive manner, where codes were not assigned to fit into a preexisting theory. Within this step, the emergence of system levels was recognized. An interpretive coding step was then performed using a three-tiered structure of codes to reveal explanatory patterns that provide an understanding of the dynamics involved between CBL practice and system levels. Elements and details captured from within the two representative cases are presented to provide an understanding of the context of each case and to highlight the scenarios in which the three system levels are revealed.

Study Limitations

The research was conducted within a single international context. As a result, any particularities that may be cultural artifacts of the region, the university, or other contextual factors may be manifested in the model. These factors must be considered for adaptation into another context. Further study is necessary to determine the extent to which this model provides for transferrable results. Although this research sought to leverage an approach that captures perspectives of multiple stakeholders, the data collection and conversation within the research originated from a university orientation. This could tend to make the model university centric. Perhaps different configurations of the model could be developed in the absence of the power and influence the university can hold within these partnerships. Additionally, the author is a proponent of STEM CBL and seeks to support the advancement of this pedagogy through evidence-based practice. This positionality may impact the findings of this work. It should also be noted that although the author followed participant-observation protocols and method, the author was still embedded as part of the system.

Study Cases

Each case is presented to explore the "who," "how," and "why" of STEM CBL practice to provide a contextual description and highlight the complexity of practice between stakeholders. The stakeholder groups, institutions, and individuals that participate, as well as the various roles embodied, are presented as the "who." The actions taken within the conceptualization, organizing, planning, implementation, and debriefing of each case comprise the "how." The justification for contributions to CBL represent the "why." Descriptions of both cases are followed by a synthesis across cases with respect to the three-tiered framework.

Case 1: The STEM Pre-College Research Fair

Described as a national movement to stimulate young scientists (grades 6–12), the STEM Pre-College Research Fair initiative has sought to support creativity, innovation, STEM proficiency, and research skills on a national scale for nearly 20 years. The initiative is a national cornerstone in Brazil for its ability to support the development

of STEM researchers and professionals. Throughout its history, this initiative has established a strong pipeline of alumni and a strong network of schools, leading to considerable education and workforce impact in the STEM field. Winners from regional fairs across Brazil compete at the national level, with winners moving on to compete at an international competition. This case study focuses on the national event, although the other associated events (regional and international fairs) are closely intertwined.

As a participant–researcher within this case study context, the author served in various roles, including member of the organizational team, evaluator judge of the research projects at multiple fairs, resource to the regional and international fairs and participants, English-language expert, committee member for the national delegation traveling to the global competition, and support/mentor role at the national and international competition. The author participated in two of the national fairs central to the case, as well as three regional fairs and one international fair.

Who

The Pre–College Research Fair initiative is supported by practitioners from across the stakeholder groups. From within the university, the event is led by an associate professor, Camila. Camila is a visionary, serving as the heart of the event as both the public face and mobilizer of resources. She leads this initiative in parallel to her technical research that she performs as an engineering professor. Camila has made an exceptional commitment to this initiative, working countless hours and contributing heavily to all aspects of this event. Unfortunately, with respect to her university promotion, her CBL contributions are not respected as much as technical research, grant funds, and publications, so her career trajectory may have been stifled by these contributions. Another strong contributor, Lourdes, works within an educational outreach role within her large company. Lourdes mobilizes resources (i.e., funding, meeting spaces, giveaways and prizes) by promoting the value of this initiative to her superiors at her company. She makes personal contributions to many of the national, regional, and international fairs by committing her time and energy to the event. Complementing Camila's role, Lourdes's contributions are tied to her primary professional responsibilities. Lourdes

is often very present in person at associated activities, yet her role consists more of providing resources than supporting the implementation of the national fair. She therefore must continue to present the value of the initiative to her company.

Camila has developed an established infrastructure of committed organizations and individuals who support the event. Supporting Camila at the university is a small but strong organizing team of administrative staff and graduate and undergraduate students. The team is structured hierarchically, so that a core team of long-time members often manages more recent additions to the team. The individuals on the core organizing team, some of whom participated in the fair as students, have established a strong commitment to this initiative. Alejandro, for example, is a current graduate student who participated in the event when he was a precollege student. The fair supported his academic development and, as a result of participation and his hard work as a student, he earned admission into UBE. Now he serves in a leadership role on the core university team. This team dedicates an entire week in December to supporting the event, as well as countless hours throughout the calendar year. This core team serves as the primary driving force within this CBL initiative. The team members work in close partnership with each other and have established strong relationships with many supporters and volunteers from precollege schools, industry, and government groups. Although the event is supported by the university, the primary responsibilities fall to the organizing team. Their interactions with participants and each other, as well as the intensity of work needed to implement the national fair, exhibit a high level of dedication. From the conceptualization and planning to the on-the-ground implementation of the event, this team is constantly present and ready to support. For example, when a glitch arose within the system built to collect the judges' marks on the student research projects, Alejandro and the team worked around the clock to solve the issue prior to the event.

Several individuals and institutions have long-term relationships with the STEM Pre–College Research Fair. These individuals come from industry, government, nonprofit groups, and precollege stakeholder groups. They provide links to financial contributions, resources for space and infrastructure

(i.e., housing meetings and workshops at the company), and expertise on workforce needs and professional experience. These individuals often serve as role models during the fair, as they walk around and chat with the participating precollege students. They serve as judges and often bring their peers, providing links to the other STEM professionals and expanding the network of those supportive of the fair. One such individual is Bella, who works for the Ministry of Education in support of STEM education. Bella obtains small government grants to support the event and promotes national discussions of the value of STEM education to the country to support maintaining the initiative as a governmental priority. As the event has a successful history across almost 20 years, student alumni of the event have created a nonprofit group that supports the development of the participating precollege students. Led by Erika, this nonprofit organization supports student success at the national and international levels, pursues job and internship placement for participants, offers role modeling and mentoring, and provides judges and consultants. Additional nonprofit organizations (primarily from educational sectors) provide funding, publish articles, and offer expertise at the event.

Around 10 precollege administrators and teachers exhibited deep commitment to the fair, as evidenced by their annual dedication to the student participants during the event. One such teacher is Ivan, who has brought students from his precollege school to the event for 9 straight years. The schools and districts of Ivan and his peer teachers have had steady participation, regularly sending multiple high-quality projects to the national and international levels of competition. Their school districts have developed pipelines of interested students who commit long hours and effort to advance research projects. Within certain regions of the country, as a result of Ivan and his peers' efforts, participation in the STEM research fairs has gained a strong cultural hold. In these regions and school districts, many students participate in the fairs, the school curricula are aligned with STEM and research development, and the teachers and community are able to support many students to be successful and even achieve and win at the international level.

The precollege students and schools are primary beneficiaries of this initiative. Students can further their educational de-velopment (both technical and professional skills), teachers and schools can enhance their curricula (through the research projects), and all parties can gain exposure to and interaction with a wide variety of professionals during and after the fair. The precollege students work hard to advance their projects, recognizing the potential for educational advancement that this established platform offers. One exemplar student is Theo, an aspiring physician/researcher in his second-to-last year of primary school who hopes to pursue a career in robotics. During this case study, Theo traveled to the event with Ivan and peers from his school in hopes of success at the fair. Theo was fascinated by the quality of judges and their ability to dissect his work quickly and pose questions that furthered his own understanding of his work. Theo responded well to the questions and won the competition, earning a place in the international STEM fair. After the victory, he and Ivan ecstatically exchanged big hugs and danced with the rest of their peers from their school, as he is one step closer to achieving his dream of being a physician and researcher.

How

The individuals and institutions involved support this CBL initiative through planning, implementation, debriefing, review, and conceptualization. Planning activities were primarily coordinated by Alejandro and the university-based administrative team. The team meetings were well organized and effective, accomplishing ambitious agendas within meetings. The experience of the team was evident as they drew from prior outcomes for continual improvements. The team met weekly as a unit and with Camila but worked in close proximity and in constant communication. Finances, logistics, recruitment, evaluation, standards, and other elements were commonly discussed. This team would often meet with representatives from the other stakeholder groups for alignment with each other's needs, about once every other month at a minimum and almost weekly prior to the national fair.

As an example, meetings with Lourdes typically considered how to optimize the value of her company's financial contributions through programming and branding. Although the event is well-respected, annual implementation requires substantial financial negotiation as the event is

not supported through endowment or on a sustainable platform. Even with financial contributions from multiple entities and sectors, variations in the policies and financial status of those who contribute can leave the budget for the STEM research fair in flux from year to year, requiring substantial fundraising efforts. Lourdes, as she has been able to continually obtain funds from her company for the event, provided insight to the team on best approaches for obtaining funding from other institutions.

Concurrently, during the fair Alejandro led the core organizing team through daily planning and debriefing meetings. For example, Alejandro and the team met with Erika from the alumni nonprofit and reflected on the best ways to enhance student performance and how the members of the organization would be most effective during the fair. The precollege practitioners prepared in similar ways, with precollege teachers supporting the student research efforts toward their strongest showing at the fairs. The competing students and their teachers invested many hours, often in and outside their classes, to produce strong research results. Those with the most experience would often reach out to the network of individuals and the university team for support and links to academics who might support the research.

During the 3–day event itself and immediately surrounding it, practitioners from across the stakeholder groups worked closely together toward the success of the fair. During the event, while newer practitioners were focused on one role at a time, those with experience within the research fair often enacted multiple roles. For example, most of the K–12 students have one role: to present their research to judges or peers. Students with more experience may serve as mock judges to support their peers. Those in the leadership roles (e.g., Camila, Ivan, Lourdes) oversee the success of their colleagues at the fair. They mingle and interact with those from other stakeholder groups, subtly highlighting return on investment for financial contributions; judge posters; and have casual or directed conversations about the STEM fields with academics and students.

Immediately after the event, debriefing discussions captured successes and limitations, as participants were already beginning to plan the next year's event. Practitioners debriefed to discuss future needs and improvements. The precollege students and their instructors discussed successes and limitations. Industry and government representatives discussed the extent to which their contributions provided value, the return on investment, and how future contributions could be made. The organizational team debriefed formally, an action primarily performed by just the core organizational team, but with some practitioners from other stakeholder groups also participating (i.e., Camila, precollege instructors, and nonprofit representatives). The organizing team would revisit the elements of the fair to a substantial extent, reviewing all elements from the sequence in which the judges reviewed posters and provided scores to the general trends observed in the students' performance. These reviews have led to continued improvements of the effort from year to year.

Efforts to conceptualize and broadly consider the approach and scope of the fair were limited. As efforts were being made to strengthen the regional and local fairs, Ivan and Camila would meet at various times throughout these efforts to conceptualize approaches and needs within these smaller, more emergent fairs. Their conversations focused mainly on how to attract more students, train more teachers for advising roles, and grow the infrastructure and integrity of the fairs.

Why

Several goals and justifications are pursued within this initiative by the practitioners from the differing stakeholder groups. Most broadly, the goals of the national–level fair and network of regional fairs include stimulating STEM workforce development, supporting society through education and innovation, providing links between precollege schools and universities, and promoting interactions between students and researchers/scientists from different backgrounds. From youth as young as 12 years old to professionals approaching retirement, the research fair is a platform where many can make contributions and benefit from the exposure to and development in STEM research toward increasing the integrity and capacity of the STEM pipeline on a national level. The different stakeholder groups pursue outcomes that parallel this overarching goal. For example, Lourdes pursues several outcomes on behalf of her company: promoting corporate social responsibility,

gaining market share through effective marketing, building brand loyalty within future STEM professionals, and developing and growing the future workforce so that her company may have suitable employees to hire in the future. Bella, within her governmental role, advances development of the STEM workforce by supporting innovation and economic strength through contributions to precollege STEM education, which can provide returns on both educational and economic development. The goals pursued by practitioners from nonprofit roles, represented by Erika and her peers, are oriented toward supporting important social causes, giving back to communities in need, or contributing to passion projects. The educational stakeholders (precollege and university), Camila, Alejandro, and Ivan, pursue the primary goal of improving STEM education, broadening participation in STEM—particularly that of underrepresented racial minorities and women—and supporting the future STEM workforce.

Because the national research fair winners would earn an opportunity to compete at the international level, this event also served as a platform for national pride. Students like Theo, who qualify for the international competition, obtain press exposure for themselves, their teachers, and their schools, and those who are awarded prizes at the international level can obtain substantial recognition for their performance both from those involved with the event and other national media outlets. As a result, the performance of the national representatives in the international fair is evaluated against global peers and fosters discussion of how to strengthen infrastructure for optimal performance.

Case 2: The Technical Citizen Collaborative

The Technical Citizen Collaborative is a university-based group of individuals within the engineering program who seek to implement projects with socially beneficial objectives to strengthen the relationship between UBE, its engineering efforts, and local social need. These projects seek to foster the development of social responsibility and recognition of the importance of social action in university engineering efforts to impact members of local communities. The collaborative serves as a clearinghouse to both university students and professors who are seeking to include or strengthen the integration of these objectives within the undergraduate engineering curriculum. Support is provided to stakeholders from outside the university who may be looking for engineering solutions or guidance on local challenges. The collaborative supports a wide variety of projects at the university, provides links to partners, and pursues funding opportunities in support of the projects.

As a participant-researcher within this case, the author served in various roles, including member of the administrative board, supporting the planning and implementation of initiatives, facilitating and supporting the implementation of activities, and observing activities while not participating.

Who

The core contributors of the Technical Citizen Collaborative are from within UBE. The collaborative is led by several faculty members, Roger, Antonio, and Edson, and one college administrator, Erika, all of whom have strong conviction and interest in linking university efforts to social need. Roger initiated the collaborative in 2004, and since then, this core team has served as board members to manage and support its success. This team dedicates a substantial number of hours to the collaborative, meeting weekly for 1–2 hours in addition to their primary responsibilities in the university, and they have done so since the collaborative's inception. Student representatives serve on the board in annual terms that can be repeated. Gabriella is a third-year undergraduate in systems engineering who is a long-term volunteer on the board. She provides student voice and supports website development, student recruitment, and other collaborative needs as they emerge. A part-time administrative staff member, Luciana, provides support by maintaining documentation, obtaining supplies, and maintaining the finances and structures of the group. Other undergraduate engineering students, such as Flavio, partner with the collaborative to align senior design projects to local community needs. The collaborative is responsible for a small room in an engineering building at UBE that serves as headquarters and is often used by students to work on projects and store materials. An industry partner, Lucas, provides support through financial contributions and resources, but does not otherwise contribute to the projects. Additional university pro-

fessors and students make contributions to the collaborative through their participation in various projects that provide support, services, and education to various targeted community beneficiaries.

The targeted beneficiaries include but are not limited to the UBE custodial staff, local primary school students and teachers, youth from a nearby underserved neighborhood, incarcerated individuals, the elderly, and citizens from a variety of venues both formal (schools, museums) and informal (street fairs, parks, markets). These projects' beneficiaries were not commonly involved in planning, although sometimes discussions and questionnaires were conducted within these groups to adapt the project efforts to their needs.

How

The board's primary function is that of a clearinghouse. It brokers relationships between representatives from across the stakeholder groups interested in making contributions through the collaborative and the engineering program at UBE. The primary interactions of the collaborative included planning for the needs of its projects and the beneficiaries, implementing the projects, and marketing the presence and services of the collaborative within UBE and the targeted communities. Administrative work was also needed so that the collaborative could continue to run effectively and show its impact within UBE. Projects, all of which support local communities through student development, are grouped into two categories: short-term and extensive. Short-term projects involve partnering with communities in need toward the delivery of educational/socially inclined activities and solutions. Short-term projects fall into three main categories: (1) hands-on efforts to promote interest and awareness in STEM education, (2) education to develop STEM literacy and abilities, and (3) the delivery of services such as supporting accessibility in technology for the differently abled. For these types of experiences, the board and/or students from the collaborative would either travel to the communities or invite them to campus to implement the short-term projects. Examples include a hands-on STEM education workshop that used street-racing carts to teach design and engineering to local youth from underserved communities, and a series of computer skills courses for university custodial staff, the majority of whom are from low-income backgrounds.

The street-racing cart project was offered annually, for 10 to 20 preteens who are invited to the campus for a workshop around building and racing the carts. Through two afternoons, preteens from a nearby community learn elements of design and get exposed to university students as mentors. Amanda was a preteen student participant in the cart design activity. She lives in a nearby underresourced neighborhood that struggles with limited infrastructure and opportunity, leading to crime. She and her peers enjoyed the activity and appreciated visiting the beautiful campus as they designed, built, and painted their racing carts. At the end of the activity, the students participated in a ceremony to receive certificates branded by UBE, a gesture intended to provide motivation to pursue academic excellence and a sense of belonging within the prestigious university.

The computer course for custodial staff comprised a series of six lessons, developed and offered weekly by undergraduate students to support the ability of custodial staff to gain and further computer skills. Vinicius, who, like his custodial colleagues, is from a low socioeconomic status, represents participants in this class. The course was offered on campus so the staff could easily attend after their shifts. From this project, the collaborative sought to develop computer literacy for groups that had little prior exposure to academics or computing to support their empowerment and future employment opportunities.

In contrast to the short-term initiatives, extensive projects are those connected to engineering undergraduate students' senior design projects, a requirement to graduate. Only a small percentage of UBE students pursue these extensive projects. One exemplar is the project of Flavio and his team, who were working to develop a device that supported reading for the visually impaired. Other extensive projects included a system to support increased recycling on campus to facilitate the process for custodial staff, and the development of a virtual learning platform to support the continuing education of those who have been incarcerated.

At board meetings, Roger, Antonio, Edson, Erika, and Gabriella review upcoming projects as well as the successes and challenges of prior projects. They discuss how to support the project teams toward successful implementation and resolve any of the collaborative's organizational needs. These

meetings are the primary opportunity for the collaborative to review its performance and the extent to which it is accomplishing its mission. Students are involved in the board meetings in several ways. For example, Gabriella is present each week and provides input from a student perspective to represent the needs and challenges of her peers on an ongoing basis. Flavio attended at least two collaborative board meetings to align his senior design team's project with individuals affected by visual impairment. The collaborative supported this project through contacting and communicating with some potential nonprofit partners. At a follow-up meeting, Flavio returned and was connected to a nonprofit via email. The collaborative's board offered continued assistance in establishing a connection in support of the project's ongoing success. At the board meetings, students like Flavio presented ideas, obtained feedback, and learned of community partners and ways they can be linked to the project.

In weeks prior to short-term projects, the board interacts closely with the undergraduate students who lead the project to provide any necessary support. Additional meetings outside the board meetings are sometimes organized to accomplish this. The implementation of the short-term projects is primarily led and developed by students. The student teams develop the projects of interest and are the primary individuals implementing the project. Substantial student effort is directed toward making sure that the project agendas and materials are established so that the targeted beneficiaries' experience is smooth and positive. The board builds and maintains relationships with community members to offset year-to-year student turnover, which can inhibit long-term relationships. Roger and an additional board member are often present during implementation of the short-term projects to provide any needed support on site. Within each of the projects, the board primarily facilitates and supports any student needs, such as providing access to buildings and being the legal supervisors of the event.

Every other year, the board holds a retreat for the collaborative off campus, in the offices of an industry partner, Lucas, who makes financial contributions to the group, sponsors projects, and provides space in his company's office. Lucas is welcoming but serves primarily as a benefactor rather than supports the internal needs of the collab-orative. During these review meetings, the board sets an ambitious agenda to revisit its organizational charter, partnerships, and outcomes to determine future needs and potential adjustments.

Why

The core objective of the Technical Citizen Collaborative is to promote socially responsible engineering practice within undergraduate and cocurricular education at UBE while supporting impact in local communities. Broadly, the goal is to support a shift in the culture of engineering so that engineers more readily recognize the need for a human-centered approach to engineering. Whereas the university is known for its technical excellence, the core leadership team supports student development and social outcomes through opportunities for students to complement the technical curriculum with socially inclined efforts. The existence of this collaborative provides an outlet for the college to support community engagement and to allow support to return to the public that funds its existence. Additionally, it provides platforms where stakeholder groups can interact within what would otherwise be a highly theoretical and technologically inclined engineering program. The short-term and extensive projects provide platforms upon which those from across the stakeholder groups can make contributions to social causes.

Through these socially inclined projects Gabriella, Flavio, and other undergraduate students are able to develop professional and leadership skills, as well as to understand more deeply how social objectives can be included in engineering. Additionally, these projects provide opportunities for students to impress potential employers with meaningful projects that highlight leadership skills and socially inclined goals. Many students also recognize the privilege of attending a renowned public university and hold desires to give back to the local community. A few participating students come from underprivileged or underrepresented backgrounds themselves and want to find ways to connect their education with their own communities. Industry representatives recognize the collaborative as a mechanism to support the university and meet company objectives toward social responsibility.

Finally, the targeted beneficiaries of the projects, such as Amanda, the preteen who participated in the race cart project, and

Vinicius, the custodial staff member learning computing, can benefit from the exposure to the CBL programming involved with each project. Although resources for STEM education can be limited, especially within underresourced communities, these projects provide brief outlets that may be valuable in the development of the STEM awareness or skills of the beneficiaries. Broader alignment of these efforts could help these projects be situated within a pipeline of efforts that truly support the development of these beneficiaries within STEM education.

Results

These case studies highlight the dynamics of STEM CBL practice. The data from within each context indicate that CBL practice can be situated within a three–tiered system structure, similar to that proposed by the NRC framework for informal STEM education (NRC, 2015) that we employ as the theoretical framework for this study. In the following section, both cases are synthesized in an analysis across cases to present a holistic representation of the dynamics at play within STEM CBL practice at each level.

Tier 1: Community Level

The community level involves the positioning and alignment of the stakeholder groups in relation to the other stakeholders, STEM, education, and CBL. At this level, philosophical approaches to CBL and the aspirational goals pursued were negotiated. Those present during community–level interactions, most commonly those within leadership roles, could work to strategically determine (1) why contributions to CBL are sought and if participation is of value, (2) what contributions to CBL can be made, (3) what outcomes can result from CBL participation, (4) what type of CBL can produce desired outcomes, (5) how to align goals with the other stakeholder groups and targeted beneficiaries, and (6) how to obtain resources to accomplish the efforts through internal mobilization and/or strategically seeking contributions from other stakeholder groups. Practitioners from across the stakeholder groups can potentially make contributions at the community level. The data from the two cases indicated that community–level interactions were not common, and when they happened it was primarily through those in leadership roles.

During community–level interactions, since high–level planning is pursued, CBL participants and beneficiaries are considered in broad definitions that often reflect the stakeholder groups (i.e., precollege, university, nonprofit, industry, and government) rather than specific groups of individuals (such as individuals like Amanda or students from a particular school or classroom). Community–level interactions commonly take place prior to and after CBL initiatives. Through community–level meetings, leaders shape and reflect on outcomes, review/consider approaches to data collection and analysis, and capture successes/limitations of goals and objectives across stakeholders. Participation from practitioners across the stakeholder groups is critical for community–level efforts, as it enables alignment. A lack of community–level planning can leave participants unclear about potential outcomes and how CBL efforts link those from across stakeholder groups.

As one example, in the national research fair initiative, Camila, Lourdes, and Ivan had brief informal discussions on how to strengthen participation and success within particular regions of the country. They sought to work together to see how they can replicate the rapid growth seen in Ivan's region, where many students participate in the fairs at a high level and many schools have established a culture of participation, to support the growth of other regions and school districts. These discussions were oriented toward the broad success of the STEM research fair initiative within the region, and not linked to the specifics of any one demographic or stakeholder. In an example from the Technical Citizen Collaborative, explicit community–level activities were limited, with the closest approximation to community–level interactions witnessed during data collection being the biannual planning meetings. However, these meetings were primarily situated within the program level. This limitation resulted in the collaborative contributing to important but unlinked initiatives. With community–level planning, the Technical Citizen Collaborative could establish a pipeline of complementary precollege initiatives to support continued development of the students it reaches.

Several limitations and factors hinder community–level efforts. One challenge involves capturing the voice and needs of those across the stakeholder groups, par-

ticularly the vulnerable and underserved. Since the efforts at this level as observed were constrained to those in leadership roles, certain populations were excluded. Potential reasons for this omission include perceptions of limited knowledge or expertise to support meaningful contributions, and the challenges of efficiently capturing voice and input from multiple demographics with differing needs. As a result, many were not represented. For example, neither in the case of the STEM Pre-College Research Fair nor the Technical Citizen Collaborative were the target beneficiaries, or even individuals who could speak on their behalf, present or providing substantial input to the conceptualization and direction of the CBL initiatives.

Providing time or bandwidth for community-level interactions presents an additional limitation. Many CBL initiatives operate under time and resource constraints. Further, tension often exists between practitioners' primary responsibilities and CBL. Therefore, efforts that could sustain community-level interactions instead are relegated toward program- or individual-level interactions. As a result, interactions of the practitioners were rarely explicitly centered at the community level. No global planning meetings in which representatives from across all stakeholder categories were present were observed. Instead, it was more common for key leaders to meet for informal discussions. They then relayed information between and across stakeholder groups, rather than practitioners from the stakeholder groups coming together for intentional community-level efforts.

Finally, realizing the many potential outcomes CBL has to offer at the broadest level (i.e., workforce development, broadening participation, and improving STEM education) is a challenge. These outcomes are difficult and impractical to measure in practice. Measurement of outcomes at this level occurs across long time spans and is expensive and difficult to obtain. As a result, data collection and assessment at this level is rare. The STEM Pre-College Research Fair has collected comprehensive data from its participants from year to year, but due to the challenges of research with minors and the cost of longitudinal analysis, measuring the impacts of the fair is difficult. In the Technical Citizen Collaborative, the projects are dispersed across many small communities. Although survey data is collected concerning the quality of each project, the projects are primarily centered on ensuring positive interactions rather than understanding the broad societal impact of the collaborative.

Tier 2: Program Level

At the program level, focus is placed on conceptualization and planning of specific CBL initiatives. In the two cases observed, these interactions were directed at a specific community or targeted beneficiary (e.g., a specific precollege school or district, or a particular center or nonprofit that supports individuals with a particular need). Within program-level interactions, practitioners focused on the following: (1) how a specific CBL approach must be adapted for the intended local context, (2) how and to what extent practitioners can obtain the outcomes that they feel are important, and (3) how to plan and implement the initiative within the specific local context.

These interactions commonly included a practitioner in a leadership role or administrator (i.e., professor, supervisor, leader of a student organization) meeting with practitioners from partner stakeholder groups who would contribute to the initiative. Meetings with the target beneficiaries (i.e., precollege students, local underserved community members, a nonprofit organization) were common as well, although these were mostly directed at capturing the needs of the beneficiaries rather than providing ownership. Repeated meetings were commonly used to plan, organize, and prepare for the implementation of the CBL initiatives. The meetings were generally one stakeholder group at a time. For example, in the STEM Pre-College Research Fair, a continued cycle of meetings was held by Alejandro and the organizing team. These included meetings with just the team (e.g., meeting to discuss the electronic judging platform), as well as meetings with representatives from other stakeholder groups (e.g., meetings with Ivan or Bella). In the Technical Citizen Collaborative, the meetings would involve the board and representatives of each project, first to establish agreement on what the project would be, then several meetings to discuss the implementation of the project itself, and a meeting to debrief around the project. The program-level efforts were generally ongoing but varied around the implementation of the CBL initiatives. Broadly, the interactions at the

program level support achieving programs' educational goals, performing research, and collecting data on the success/impact of the event.

Program-level evaluation was commonly pursued and used to inform the success and impact of the initiatives themselves, typically to justify the contributions of the practitioners or obtain resources. In the STEM Pre-College Research Fair, comprehensive data were collected on the students who participated, their schools, and their results/marks from the judges. Bella and Lourdes use this information to pursue funds; the university team use the data to pursue funds, improve the event, and understand the impact of the event on those who participate. In the Technical Citizen Collaborative, minimal data was collected, but most was oriented toward improving the program, which in turn can improve the learning outcomes of the beneficiaries.

Limitations at the program level involve shaping CBL initiatives to suit the goals of the stakeholder groups that may be involved and the extent to which programming is adapted to the local context. In the STEM Pre-College Research Fair, it is recognized that in some regions, the culture of participating in the fairs has not yet been established. The team hypothesizes that this lack of growth may be due to a lack of alignment between the research fairs and the local precollege context. The Technical Citizen Collaborative struggles with communication and clarity between differing stakeholder groups to ensure that mutual outcomes are obtained in practice and that implementation is handled smoothly. Across both cases, implementing the event(s) requires substantial energy and resources (i.e., person-hours, funding, communication and alignment with stakeholders). Similar to the community level, capturing the voice of targeted beneficiaries, which are often underserved communities, is a challenge and can limit the extent to which nonuniversity outcomes are obtained. In the STEM Pre-College Research Fair, because the event has such extensive infrastructure, it can be difficult to capture the voices of the student participants to shape the event to their needs. In the Technical Citizen Collaborative, the targeted beneficiaries like Vinicius and Amanda are often dispersed individuals with limited unity or power. As a result, capturing their voice and perspectives can be difficult, and

their limited education can often preclude their offering expertise in their own lived experience.

Tier 3: Individual Level

At the Individual level, focus is placed on the immediate success of those within a CBL initiative. These interactions, which center around the CBL practitioners and beneficiaries, are often the primary platform upon which the goals of CBL efforts are obtained. Here, practitioners negotiate (1) what can be gained from CBL participation and (2) what can be provided to the beneficiaries. Goals and outcomes are directed at individual needs, contributions, and goals of both practitioners and beneficiaries. The outcomes pursued by practitioners commonly include developing a sense of citizenship and making contributions to social needs and/or STEM education. These outcomes are often pursued in parallel to the outcomes intended for the beneficiaries, which generally revolve around supporting their STEM education and development.

Individual-level interactions primarily occur during CBL initiatives but can also take place throughout the planning stages. For example, in the STEM Pre-College Research Fair, nearly all of the practitioners had personal interactions with the precollege students participating in the fairs. These ranged from holding brief conversations to establishing or furthering deep mentoring relationships. For example, Camila, Lourdes, Bella, Ivan, Alejandro, and others often spoke with the fair participants to discuss their research and speak about career ambitions and trajectories. These interactions were personal, involving many smiles and hugs. These interactions often were referenced by the practitioners as what made the hard work and sacrifices for CBL worth it. At this level, student voice is captured by the practitioners, although in these personal moments it appears the practitioners were no longer working toward CBL contributions, but instead were serving in roles as mentors, focused on being present and sharing special moments. In the Technical Citizen Collaborative, the attention and care put forth by the CBL practitioners on behalf of the beneficiaries provided a positive outlet for many in difficult situations. The joy of the youth racing the carts and the custodial staff learning new skills was valued by all involved. These individuals' interactions not only promote the advancement of the

initiative but also establish strong ties be-tween the individuals and produce positive energy that supports sustaining the event and promoting its success.

Evaluation of individual-level outcomes includes collecting data related to how par-ticipation impacts the professional develop-ment of participating students, the learning outcomes of targeted beneficiaries, and the success of the event in terms of its abil-ity to support the targeted beneficiaries. In the STEM Pre-College Research Fair, the students receive feedback, both informally through the conversations with judges and professionals at the fair, and formally through the scoring and review system of the event. In the events sponsored by the Technical Citizen Collaborative, however, the surveys and questionnaires adminis-tered were used for informing the program; results were not relayed to the participants to inform their growth or development within the context of the STEM learning.

Limitations at the individual level include stakeholders not being aware of what can be obtained from or offered to CBL. Many practitioners link CBL to charity, not recog-nizing the deeper potential for educational or social justice outcomes. Limited aware-ness of the developmental opportunities possible within CBL prevent many practi-tioners from pursuing them. Additionally, many individuals can struggle from burnout and exhaustion within these efforts. In both the STEM Pre-College Research Fair and the Technical Citizen Collaborative, the practi-tioners exhibit a high level of dedication, yet the CBL efforts are a primary responsibil-ity to few. The amount of time and energy provided to the event can commonly re-quire those involved to extend themselves and make personal sacrifices that can have negative implications both personally and professionally.

Discussion and Implications for Research and Practice

The case study approach to this research establishes observed phenomena that high-light the presence of three levels. Through a further level of abstraction from the in-dividual cases, a model that advances the structural understanding of STEM CBL is proposed. These levels are synthesized in Table 1 to describe how the initiatives, stakeholder characteristics, and outcomes/ goals can be manifested in CBL practice.

This work contributes to the current CBL literature in two primary ways: (1) intro-ducing empirical evidence showing that three system levels can appropriately de-scribe STEM CBL and (2) illustrating how knowledge of the levels can support STEM CBL research and practice.

Describing STEM CBL With a Three-Tiered Structure

Hierarchies with the practitioners, their interactions, and the outcomes produced suggests three primary levels are impact-ful in STEM CBL practice. The practitioners include those in leadership roles who con-ceptualize efforts; administrators, teachers, and students with high levels of experience who develop and plan initiatives; and a range of novice to experienced individuals who support implementation of the activi-ties. These primary CBL practitioners seek to support the targeted beneficiaries, often individuals from underserved or developing communities. This tiered structure links to prior research, which has suggested that CBL partnership appears to contain sev-eral multilayered, multisector partnerships (Bringle & Hatcher, 2002; Mulroy, 2004). The empirical findings of this study provide contextual evidence that as CBL practice shifts from community to program to in-dividual levels, the approaches of the prac-titioners, their interactions, and their goals become increasingly specific and targeted. Although these levels may not be explicitly considered in practice, the observed phe-nomena suggest multiple levels are impact-ful (Bringle & Hatcher, 2002; Mulroy, 2004). The ways in which the three levels describe the two STEM CBL cases, as shown in Figure 2, indicate that this is a valuable approach, yet more levels across the system as well as levels within an individual stakeholder group could be explored in further research.

Knowledge of the Levels Supports STEM CBL Research and Practice

As illustrated within the cases, as well as through prior descriptions of CBL, STEM CBL practice is inherently complex (Bringle & Hatcher, 2002; Burton et al., 2019; Miller, 2008; Strier, 2010). A three-tiered structure supports navigating the complexity of STEM CBL practice in two ways: (1) promoting clarity for roles, tasks, and outcomes and (2) supporting awareness of how to distrib-ute effort across CBL needs.

Table 1. Implications of the Three Levels on STEM CBL Practice

Level	Stakeholders	CBL Stakeholder Interactions	Outcomes and Goals
Community	• Focus on broad stakeholder categories (i.e., pre–college students, the elderly, or the underserved) • Leadership/select representatives from stakeholder groups provide direction for CBL contributions; some voices may rarely be captured (i.e., the underserved, the youth)	• Conceptual consideration and broad alignment in support of STEM CBL efforts • General approaches that support that advancement of STEM in line with general needs of the stakeolder groups • Alignment of outcomes across stakeholder needs and interests	• Promotion of STEM education and workforce development within and across the stakeholder groups • Social responsibility, market share/brand loyalty for industry • 3–5 year timelines, difficult to measure, emergent outcomes (i.e., workforce development, access and awareness of STEM)
Program	• Focus on specific organizations, institutions, and/or groups (i.e., pre–college students from a single or group of schools, underserved populations from a selected neighborhood) • Leaders, administrative teams, and students provide the needs of specific CBL initiatives	• Organization and implementation of specific initiatives that involve multiple stakeholders and seeks to promote impact through CBL • Debrief, data collection, and refinement for future efforts within specific initiatives	• CBL goals implemented through specific CBL activities (i.e., curricular enhancements, CSR); Supporting the development of innovation and STEM learning; Delivery of engineering/educational solutions • 0.5–3 year timelines, measurement of outcomes through research, administrative data collection, and aggregate measures of student achievement
Individual	• Focus on one–on–one and small group interactions with a high amount of personal involvement • Administrative teams, students, and staff provide for direct implementation of CBL activities seeking success with individual beneficiaries	• Implementation and success of single iterations of CBL activities and programs "on the ground" • Efforts are directed towards impact and development of individual practitioners and targeted beneficiaries of the CBL activities	• Individual outcomes (i.e., educational gains, development/practice of citizenship, individual contributions to STEM education/community needs) • Several hour–6 months timelines, educational outcomes often assessed, community/non–educational outcomes are measured less often
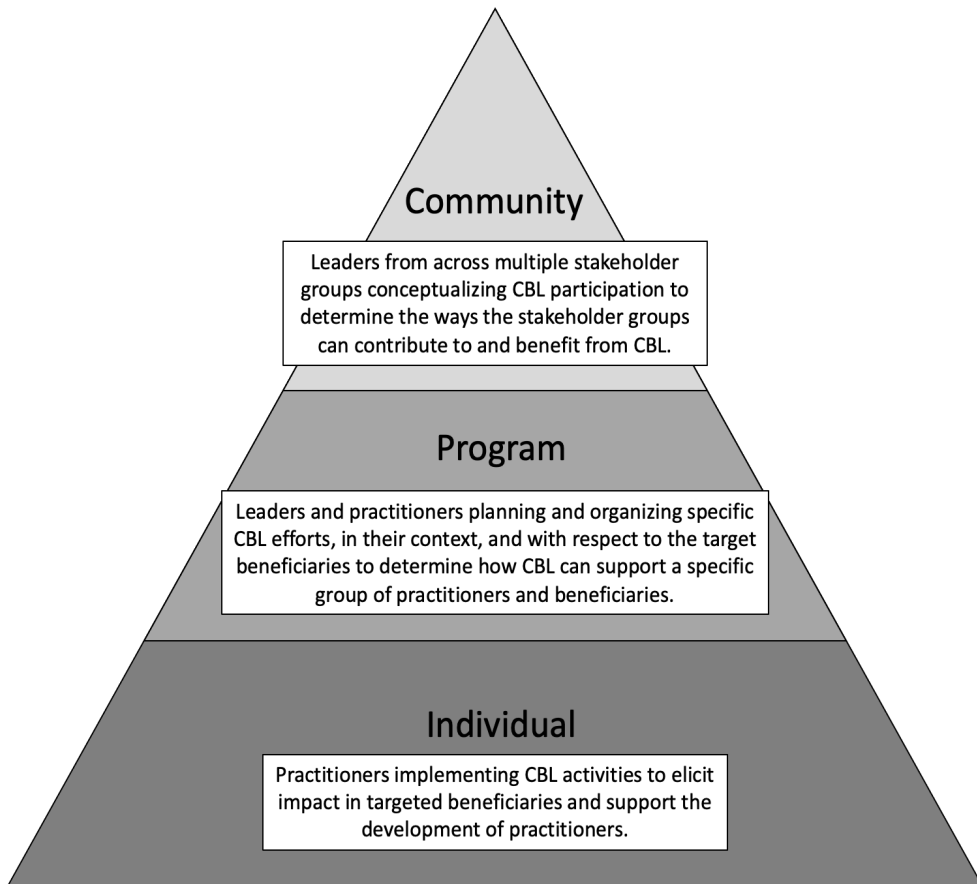
Figure 2. Three-Level Model for STEM CBL Practice

Promoting Clarity for Roles, Tasks, and Outcomes

Because a wide variety of stakeholders can make CBL contributions, leveraging the three-tiered model can help practitioners locate a role, approach, and outcome, as identified in Table 1. Practitioner ability to explicitly name and point to these levels, as suggested by Burton et al. (2019) with respect to the phases of service-learning, can enhance alignment and outcomes among stakeholders. Conceptualization and broader impact, planning and program-level outcomes, and implementation toward individual gains are the main contributions to CBL at the community, program, and individual levels respectively. Miller (2008) pointed to community-level actions in recognizing that dispersed leadership can effectively guide joint action across stakeholder groups to overcome the often dispersed, diffused, and unfocused goals within CBL. Furthermore, Miller pointed out that it is easy for leadership across stakeholder groups to become too broadly dispersed to be effective and that strategic action, which takes place at the community level in the proposed model, can alleviate these inefficiencies. At the program level, Mulroy (2004) pointed to awareness of the scope and density of relationships to help leaders better understand how and why programs are complex and labor intensive. Bringle and Hatcher (2002) suggested that relationships at the individual level can support examination of CBL partnerships to promote a better understanding of institutional and personal action steps that can be taken to initiate, develop, maintain, and nurture healthy partnership. Mulroy (2004) has found that the greater the extent to which university practitioners can know and understand the desired outcomes, the beneficiaries, and the organizations that serve the beneficiaries, the more motivated they may be to develop and sustain ties, pointing to effort across program and individual levels.

Practice that seeks connections between the system levels can support stronger alignment and outcomes and thereby promote

a well-rounded approach to CBL. Those who can clearly understand the structure and opportunities for contributions across the levels are able to strongly support CBL practice. Miller (2008) observed that practitioners with in-depth experience and knowledge of multiple university, school, and community positions can be effective guides within partnerships that bring together highly diverse groups with the intention of achieving common goals. These individuals are aided by unique, lived understandings, and they can skillfully unite disparate groups that might otherwise be limited by discrepant conceptualizations of goals, responsibilities, and capacities. This ability is commonly seen in participants who have made long-term contributions as well as those who have made contributions from various roles and various stakeholder groups, pointing to the value of developing and retaining practitioners so they may continue to make increasingly valuable contributions over time.

Additionally, the three-tiered approach can support research through highlighting which phenomena and outcomes are most likely present and where. The consideration of enhancing societal implications of CBL, strengthening programming and curricula within CBL, or maximizing the learning outcomes and positive experiences of the individuals involved should leverage approaches that center the community, program, and individual levels respectively.

Supporting Awareness of How to Distribute Efforts Across CBL Needs

Emphasis on one CBL level over another can leave gaps in practice. It has been noted that CBL partnerships often neglect communication and trust-building to instead focus on implementation; however, opportunities to pause and reflect at crucial junctures can greatly benefit the outcomes (Bartel et al., 2019). As practice can be unevenly distributed across the levels, with emphasis often at the program and individual levels, additional effort within the community level provides an additional avenue for practitioners and researchers to promote holistic CBL practice. Broad conceptualization allows practitioners to describe how CBL can provide value to those involved. Community-level outcomes are often hard to perceive and measure. Individual-level outcomes feel good to those involved and can provide substantial motivation for CBL

practitioners but rarely fill educational achievement gaps or produce substantial change on their own. Further work on the ways in which practitioners can recognize community-level outcomes can perhaps promote increased efforts on this level.

Practitioners from across the stakeholder groups can potentially make valuable contributions across all levels of the system. However, community-level contributions are often confined to those with leadership roles, influence, and substantial CBL experience, while students and targeted beneficiaries are often constrained to contributing at the program or individual level. As a result, STEM CBL as observed within this landscape could be described as a primarily bottom-up phenomenon. This could point to some of the limitations in how CBL is institutionalized, valued, and perceived within universities and the other stakeholder groups. Within this structure, some have substantial voice and others do not, pointing to both limited voice and an imbalance of power commonly described in these partnerships. Stakeholder voice is a critical element for success across stakeholder groups within CBL. Strier (2010) suggested that the strength of CBL partnership depends on the capacity of the leaders to provide a participative organizational structure capable of making room for the supplementing, competing, or conflicting agendas of those involved. Recognizing the levels can help capture voice and promote its value within the power structures more effectively. This finding provides more context to previous research on the imbalances of power within university–community partnerships.

Morton (1995) suggested that CBL partnerships too often rely on charity rather than reciprocity or social justice outcomes. As highlighted by Strier (2010), meaningful university–community partnerships capable of carrying out transformative political agendas can be improved by the equal and lived inclusion of excluded social sectors, suggesting that finding ways to incorporate the voices of the targeted beneficiaries and underserved across the levels can enhance outcomes. An understood goal of CBL is reciprocity (Dostilio, 2017). Thus, the three-tiered model's support for the practitioner's ability to recognize where they fit into the structure can strengthen the potential of benefiting from and contributing to CBL. Community-level conceptualization and

communication across the stakeholder groups can facilitate moving beyond charity.

Conclusion

STEM CBL is a pedagogical tool that holds substantial promise as a platform upon which contributions can be made and benefits obtained from multiple sectors of society. This promise is often limited in practice, yet increased empirical research can establish knowledge that can strengthen reciprocity amongst stakeholders. Participant observations within two STEM CBL cases provide a nuanced and robust understanding of the CBL relationships and structures, showing that practice in STEM occurs within a diverse, dynamic, and emergent system. It is shown that three levels of practice can provide an appropriate structure for characterizing CBL and limit the negative implications of such complexity.

Although recent efforts within STEM have increasingly called for reciprocity and community-oriented outcomes, much work remains to be done as STEM CBL research is primarily centered on academic outcomes. It is suggested that CBL partnerships must "find ways to preserve the integrity of each partner, and at the same time, honor the purpose of the relationship and growth of each party" (Bringle & Hatcher, 2002, p. 513). Partnerships are most meaningful and lasting when individuals can recognize that the other practitioners and stakeholders are contributing in a meaningful, effective manner to activities that can positively impact important civic and campus outcomes (Bringle & Hatcher, 2002; Zimmerman & Rappaport, 1988).

The proposed model, highlighting three levels of STEM CBL practice, points to the primary behaviors and actions that are relevant to each level to support clarity on roles, actions, and outcomes for differing stakeholders and how these roles, actions, and outcomes change within differing levels of the landscape. Through leveraging this exploratory model, practitioners and researchers can recognize the implications of working within and across system levels in partnership with multiple stakeholders to strengthen CBL approaches and outcomes. Because multiple stakeholder categories and representatives, each performing complementary yet differing roles, often contribute to CBL initiatives, the presence of uneven power dynamics is inevitable. Ensuring that the effort of participating stakeholders is distributed across not only stakeholder groups but also across the community, program, and individual levels can support positive outcomes within CBL practice.

Collectively, recognition of levels of CBL practice, and the corresponding interstakeholder dynamics, can serve practitioners and researchers as a framework to support acknowledging the breadth of stakeholders, roles, and interests possible within CBL. As researchers and practitioners embrace the diverse, dynamic, and emergent system behavior within CBL, further equitable and reciprocal outcomes can be obtained by seeking to actively include the voices of all stakeholders across all levels. Additional attention should be devoted to including, acknowledging, and respecting the voices of community partners/beneficiaries and those often marginalized so that CBL initiatives can more effectively support community need in reciprocal fashion.

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STEM Outreach: Are We Making a Difference? A Case Study Evaluating the Science and Engineering Challenge Program

Stephanie Reed, Elena Prieto, Terry Burns, and John O'Connor

Abstract

Science, technology, engineering, and mathematics (STEM) outreach programs aim to increase participation in STEM fields. However, the impact of these programs is rarely measured due to inherent difficulties in conducting long-term evaluations. This article presents a decadal evaluation of the Science and Engineering Challenge (SEC), an Australian STEM outreach program. From 2006 to 2015, 5,210 high school and 2,445 first-year university students were surveyed to assess whether the SEC influenced their decision to pursue STEM studies. Of the high school physics students, 51.9% reported that the SEC influenced their decision to study physics. A smaller yet significant impact was reported by chemistry (35.2%) and mathematics (32.0%) students. Further, 30.9% of university students indicated that the SEC influenced their decision to pursue a STEM degree. These findings demonstrate that long-term evaluation of outreach program effects is achievable and that outreach programs can indeed have a demonstrable impact on student career choices.

Keywords: engineering outreach, evaluation, secondary school, high school, STEM

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There is widespread agreement that innovation is essential to solve global humanitarian and environmental issues, drive economic growth, and maintain living standards typical in developed countries (Deloitte Access Economics, 2019; Henriksen, 2012; Marginson et al., 2013). Many governments recognize the importance of science, technology, engineering, and mathematics (STEM) for driving innovation (Australian Industry Group, 2015; OECD, 2012). However, despite this awareness, many countries are facing a shortage of STEM-skilled employees (Engineers Australia, 2019; Henriksen, 2012; Plotkowski, 2012; Wang & Degol, 2013).

In an effort to mitigate these shortages, governments, private providers, industry groups, and universities internationally have developed and implemented a wide range of STEM outreach programs for young people (OECD, 2012; Sadler et al., 2018). These programs, formally defined by Vennix et al. (2017) as the delivery of educational STEM-based activities to K–12 students (and their teachers) by STEM-based organizations, have proliferated at such a dramatic rate that more than 250 can now be found in Australia alone (Commonwealth of Australia, 2016). Although the end goal of STEM outreach is to increase the number of students pursing STEM careers, individual programs often focus on diverse aspects of STEM, such as scientific literacy support for students, STEM-based pedagogy assistance for teachers, encouragement for underrepresented minority groups to pursue STEM careers, and providing exciting learning opportunities that are not usually available in schools for students (Australian Government Chief Scientist, 2016; Carpenter, 2015; Dabney et al., 2012; Illingworth et al., 2015; Jeffers et al., 2004; Kong et al., 2014; Markowitz, 2004; Şentürk & Özdemir, 2014; Vennix et al., 2017).

Challenges in Evaluating STEM Outreach

Despite ongoing heavy investment in outreach and claims that without these programs there would be greater shortages of STEM-skilled professionals than currently projected, examinations of the long-term outcomes of STEM outreach programs are largely absent in the literature (Bogue et al., 2013; Husher, 2010; Inspiring Australia Expert Working Group, 2011; Sadler et al., 2018). These long-term examinations are arguably one of the few methods available to ascertain whether outreach has an impact beyond initial enjoyment of specific programs (Todeschini & Demetry, 2017).

When evaluation of specific STEM outreach programs does occur, results are largely favorable; however, such studies tend to measure short-term changes in the attitudes and knowledge of different stakeholders such as teachers, students, or carers, rather than evaluating long-term outcomes or demonstrable causal relationships (van den Hurk et al., 2019). One reason for this might be that outreach programs are, quite simply, difficult to evaluate (Plotkowski, 2012). Sadler et al. (2018) interviewed staff members involved in various STEM outreach efforts at Australian universities who highlighted factors that present obstacles to STEM outreach evaluation, such as a lack of time and resources, particularly for long-term evaluation, which can be extremely costly, as well as the difficulty in accurately measuring changes in student aspirations. In addition, nonrandom allocation of students to outreach programs, for financial or program-specific reasons, often makes control groups unfeasible, meaning that causal inferences about the effectiveness of programs can rarely be made (van den Hurk et al., 2019).

As a result of these difficulties, short-term assessments, occurring immediately after STEM outreach programs and events have been run, and often focusing on measures other than student aspirations, are popular methods of evaluation. These evaluations typically use pre- and postprogram surveys and focus on outcomes such as general student enjoyment of the program or the perspectives of stakeholders involved in delivering programs (Carpenter, 2015; Forbes & Skamp, 2013; Laursen et al., 2007; Rennie, 2012; Sheehan & Mosse, 2013), as well as student perceptions of specific program activities (Falk & Storksdieck, 2005;

Şentürk & Özdemir, 2014; Vennix et al., 2017). Relatively few focus on evaluating student aspirations for STEM education and careers. Those that do so, however, generally report positive outcomes. For example, Chalmers et al. (2014) reported that 94.4% of surveyed participants would consider studying STEM subjects in the future due to their participation in the Robotics@ QUT program. Similarly, Illingworth et al. (2015) found that, after attending a one-day university-based event, students reported being 46% more likely to pursue a career in science. However, given that these surveys were taken immediately after participation in the program, long-term benefits to students' aspirations (resulting in post-compulsory STEM participation), as is the overall goal of STEM outreach, cannot be assured.

Correlational studies between general participation in out-of-school science activities and interest in STEM subjects and careers are the most popular long-term methods of STEM program evaluation (e.g., Dabney et al., 2012; Henriksen et al., 2015; Kong et al., 2014; Lyons & Quinn, 2013; Whiteley & Porter, 1998). These studies also typically reveal positive results, but they cannot draw conclusions about the effectiveness of specific programs. Dabney et al. (2012) provided one example of this type of study, finding that U.S. university students who reported having participated in science clubs and competitions at least a few times a year during secondary school were 1.5 times more likely to report interest in pursuing STEM careers after university. Similarly, in a survey of Australian university students studying science, technology, and engineering, 25% rated STEM outreach as an important or very important factor when choosing their course (Lyons & Quinn, 2013).

Three studies that focus on specific programs and examine their impact on long-term student career and study decisions are those by Bogue et al. (2013), Markowitz (2004), and Husher (2010). To assess the efficacy of an engineering summer camp in the United States, Bogue et al. (2013) used pre- and postsurveys coupled with university admission data. They found that although 13 of the 15 senior secondary students surveyed indicated immediately postcamp that they wanted to study engineering at the organizing university, only two later enrolled. These findings highlight the limitations of evaluations occurring immediately after an

intervention alone. However, it is important to note that this study relied on a small sample size and limited data; it is possible that the participants enrolled in engineering at a different university. Markowitz (2004) utilized a survey to retrospectively measure the influence of a summer science camp on students' desire to pursue a STEM career. Camp participants were surveyed between 1 and 7 years postparticipation. Of the 98 participants who responded, 80% indicated that participation in the camp contributed to their interest in a science career; however, as analysis involved grouping all students (1–7 years after their participation), it is unclear whether this percentage differs for students at different time points after their participation in the program.

Husher (2010) performed both short- and long-term preliminary evaluation of the outreach program under evaluation in this article, the Science and Engineering Challenge (SEC). Surveys were administered by Husher prior to, 2 weeks after, and 12 months after participation. In addition, post-only surveys were administered to older cohorts of students 24 months and at least 36 months after participation in the program. Survey responses (N = 252) revealed that 2 weeks after participation 91% of students felt that the SEC was a worthwhile experience, and most students felt that the program had provided them with a better understanding of what scientists and engineers do. No significant difference was noted between these responses and those obtained one year later. Additionally, approximately 30% of students surveyed after 2 weeks, 12 months, and 24 months indicated that participation in the SEC influenced their intention or decision to study physics or mathematics in senior secondary school; a smaller proportion, approximately 15%, indicated the same for chemistry. Of university students surveyed, 34% and 14% of those who had participated in the SEC indicated that the program had influenced their decision to study senior high school science and mathematics subjects, respectively. Further, approximately one third of university students surveyed who had participated in the program retrospectively identified the SEC as a factor that influenced their decision to pursue university and/ or undertake their current STEM degree. Although these findings were very positive, they relied on data from relatively small samples; n = 69, 49, and 109 for the 12-month, 24-month, and university student

surveys, respectively. This article extends this data, using 10 years of survey information to overcome this limitation.

Overall, the influence of specific STEM outreach programs on students' decisions to pursue STEM study and careers long-term still remains largely unclear due to the lack of studies directly addressing these outcomes. This article aims to address these outcomes by conducting a long-term evaluation of a particular STEM program, the SEC. Such individual program evaluations are important, given the proliferation of STEM programs worldwide. The evaluation draws upon similar methodologies to that employed by Bogue et al. (2013) and Markowitz (2004), and builds upon the previous study by Husher (2010), to provide meaningful information about the potential long-term impacts of individual STEM outreach activities.

The Science and Engineering Challenge

The SEC is a STEM outreach program founded by the University of Newcastle, Australia, in the year 2000, consistent with its mission: "Through the provision of meaningful, hands-on experiences we aim to inspire more young people to make a difference in the world by choosing a career in science and engineering." The SEC is a competitive, workshop-based program that offers Year 9 and 10 students an immersive, practical experience that demonstrates what it would be like to work in STEM occupations. The SEC aims to achieve its mission by providing students with an opportunity to compete in engaging STEM activities that are specifically designed to have multiple correct solutions; are hands-on; and require innovation, creativity, problem solving, and teamwork to achieve success.

The SEC works alongside local organizing committees—composed of representatives from Rotary International, local universities, local schools, and many other not-for-profit, government, and industry groups—to deliver centrally located one-day events that may be attended by up to eight school teams, each represented by up to 32 students. These students work in teams of three or four, competing in either two half-day activities or one whole-day activity. Activities include building a balsa bridge and testing its weight-bearing capacity, designing and racing a small-model hovercraft, or building a functional prosthetic hand from supplies including straws

and string. The SEC competition has three levels. At a regional challenge day, described above, each individual team's score contributes to their school's overall score. The top-scoring schools progress to the next stage of the competition, the Super Challenge state final. At the Super Challenge, schools from multiple regions compete against each other to represent their state at the National Final, an annual event held at a nominated venue.

This study aims to compare the findings reported by Husher (2010) to those obtained from surveys, administered to high school and university students over a 10-year period for quality assurance purposes, to answer the research question: Does participation in the SEC influence students' decisions to study STEM subjects in senior secondary school or STEM degrees at university? Given the identified need for greater representation of both women (Lyons & Quinn, 2013; Nadelson & Callahan, 2011) and ATSI (Aboriginal and Torres Strait Islander) peoples (Marginson et al., 2013) in STEM fields, we have, where possible, considered student responses not only as an entire cohort but also for male and female and for ATSI and non-ATSI students separately. Although the SEC does not specifically aim to attract female and ATSI students into the STEM pipeline, the impact of the program on these students is very important, given the disparities in their STEM participation.

Method

The evaluation draws on data obtained from two different retrospective questionnaires. Approval to utilize data from both surveys for secondary analysis was obtained from the University of Newcastle's Human Research Ethics Committee (HREC). Both surveys were designed specifically to be noninvasive and to maintain respondent anonymity. As explored in the literature review, analysis of data obtained from retrospective questionnaires has been utilized in similar studies, such as those by Dabney et al. (2012), Kong et al. (2014), and Lyons and Quinn (2013) to examine the self-reported influences of exposure to general and specific STEM outreach programs on student interest in, or decision to study, STEM.

Survey Instruments and Sample

Survey 1

The first questionnaire (Appendix A) utilized for evaluation is the High School Student Survey (HSSS). The HSSS is a retrospective postprogram questionnaire administered directly by the SEC as a measure of program performance. The HSSS was administered from 2006 onward to Year 11 and 12 students studying physics, chemistry, or mathematics (the enabling STEM subjects) who had chosen their Year 11 and 12 courses at least one year beforehand, and who had participated in the SEC in the previous 2 calendar years. Prior to 2010 the surveys were paper based, and they were distributed by the teachers to Year 11 students only, so there was no question relating to year level. After that year, the survey was web based and open to a greater cohort of students. Of the 5,210 students surveyed, 95.5% were Year 11 (comprising 3,538 paper-based respondents and 1,439 web-based respondents), and 233 were Year 12 (solely from the web-based survey). The HSSS gathers information on enrollment in science subjects and whether the SEC influenced students' decisions to study these subjects. Further, the survey asks if students found the SEC rewarding and if they had gained career/course information from their participation.

In total, 5,210 students completed the survey. The only demographic information obtained by the survey is year level and gender. In regard to gender, 54.4% were male and 45.5% were female; only 0.1% chose not to specify gender. Most students were enrolled in multiple enabling subjects, with 96% of students enrolled in mathematics, 65.6% in chemistry, and 59.7% in physics. It is important to point out that in New South Wales, where most responses came from, mathematics is not compulsory in the senior years (Years 11 and 12). It is also of note that overall enrollment of senior secondary school students in these subjects is significantly lower than enrollment of the respondents of Survey 1. In 2017, for example, mathematics enrollments in Year 12 were 72%, in physics 13%, and in chemistry 15% (Jaremus et al., 2019).

Survey 2

The second set of data was obtained from the University of Newcastle's (UON) Commencing Student Survey (CSS; Appendix B), an online long-term ex post questionnaire that directly asked all newly enrolled UON students whether the Science and Engineering Challenge had impacted their tertiary study decisions, including choice of

degree and university. This survey is administered by the university, and student demographic data were obtained from their enrollment records. The survey collected data indicating the impact of participation in the SEC on study decisions at three levels:

1. the influence on Year 11 and 12 subject choices,

2. the students' decision to study at the UON, and finally

3. whether the SEC influenced students' decision to pursue tertiary study in STEM fields.

The survey was offered to students electronically on an opt-in basis in the years 2010, 2012, and 2015. The average response rate over these 3 years was 25.1%. A total of 2,445 students completed the survey. A large proportion of the survey respondents were female (71%). Students from ATSI backgrounds were well represented, with 2.4% of respondents identifying as such. The proportion of students who identified as ATSI is close to the overall proportion in the Australian population, which was 3% at the 2015 Australian census (Australian Institute of Health and Welfare, 2015). The university that hosts the SEC has a focus on providing access to tertiary studies to students from nontraditional backgrounds, which includes non-English speaking background (NESB, 12.03% of 2016 undergraduate enrollments) and ATSI students (3.57% of 2016 undergraduate enrollments). It must also be noted that 1.7% of respondents identified as NESB, but 1.8% of responding students did not specify NESB or ESB status.

Students surveyed were commencing degrees in a variety of departments (in Australia known as faculties). The Faculties of Science and IT, Engineering, and Health, all of which have strong foundations in STEM, made up 19.1%, 10.1%, and 24.0% respectively of the total student responses. The Faculty of Education and Arts made up 37.1% of the total cohort, and the rest were enrolled in the Faculty of Business and Law. For comparison purposes, Table 1 shows the percentages of enrollments per faculty at the university in the 3 years when the survey took place.

Analysis

A significance level of less than 5% ($p < .05$), was considered statistically significant for both survey analyses. Of note, it was not feasible to have a control group for either survey analysis, as both refer to questions that were relevant only for students who had attended the SEC.

Survey 1

Yearly data obtained from the HSSS were amalgamated in the SPSS statistical software program and cleaned to remove responses from students who had not attended the SEC. These students were removed because they were unable to answer questions about the SEC due to their nonparticipation. Three analyses were then conducted with the survey data. First, the question of whether students found the SEC rewarding was examined to determine the proportion of students overall, and from each demographic group, who agreed. The statistical significance of these proportions was examined using the Pearson chi-square nonparametric test, with the expected frequency of positive responses being zero. A nonparametric test was chosen since our aim was to test group differences when the dependent variable is measured at a nominal level (McHugh, 2013). Second, analysis of the self-reported influence of the SEC on

Table 1. Total Enrollments at UON			
% Enrollments per Faculty	**2010**	**2012**	**2015**
Business and Law	16%	15%	15%
Engineering	13%	14%	14%
Education and Arts	33%	30%	27%
Health and Medicine	19%	21%	23%
Science and IT	19%	20%	21%
Total	**8,364**	**8,577**	**8,388**

the decision to study physics, mathematics, or chemistry was undertaken. For students who reported studying each subject, a contingency table was developed using the custom table tool in SPSS. The influence of the SEC on student decisions was examined by gender for each cohort that the HSSS was administered to. The percentages of male and female students who felt that the SEC had influenced their decision to study mathematics, physics, or chemistry were graphed and linear trends generated.

Finally, extended responses to open questions were analyzed in NVivo. Each statement was coded inductively into one or more discrete categories.

Survey 2

Three analyses were conducted after cleaning data in the same fashion as for Survey 1, removing students who did not participate in the SEC. First, the question of whether the SEC had influenced the university students' subject choices in senior secondary school was examined to determine the overall proportion of students who agreed, as well as any differences between genders, ATSI and non-ATSI students, and NESB and ESB students. The statistical significance of these proportions was examined using the Pearson chi-square nonparametric test, with the expected frequency of positive responses being zero (as our null hypothesis was that no students were influenced by the SEC).

Second, the influence of the SEC on a student's decision to enroll at the University of Newcastle was examined using the Pearson chi-square test in SPSS. Examination of the influence of the SEC on the decision to study science or engineering at the university level was examined first for the whole data set, and then by the faculty in which students were enrolled. The proportion of students who responded positively in each faculty were compared using z-tests, where each test was adjusted for all pairwise comparisons using the Bonferroni correction. The null hypothesis was that all faculties would have an equal proportion of students responding that the SEC influenced their decision. Responses to this question were further examined by gender and by whether students identified as ATSI or NESB.

Finally, extended responses to open questions were analyzed in NVivo. Each statement was coded inductively into one or more discrete categories.

Results

High School Student Survey

In this section we present a summary of relevant data from the Survey 1 (see Table 2) as well as a detailed analysis of associations between the different variables.

Of the students who responded that they were enrolled in physics, 1,534 indicated that participation in the SEC had influenced their decision to take this course in senior high school. This amounts to 51.9% of students studying physics (59.1 = 29.4/ [29.4 + 27.2]) and is a statistically significant proportion, X^2 (1, N = 2,936) = 5.31, p = .021. Examination of the positive response rates by gender revealed that 54% of female students and 50% of male students who had chosen to study physics identified the SEC as an influencing factor. The difference in positive response rate between genders was statistically significant, X^2 (1, N = 2,936) = 4.95, p = .026. Figure 1 illustrates the percentage of students who responded "yes" to the question "Did the SEC influence your decision to study physics?" by calendar year. Linear regression modeling of the positive response rate was carried out separately for male and female cohorts by year, revealing positive trends for both genders. R^2 values for the two regression models were 0.1522 and 0.6899 for female and male physics students, respectively.

Of students enrolled in chemistry (n = 3,259), 35.2% responded positively to the question "Did the SEC influence your decision to study chemistry?" Females were more likely to indicate that the SEC influenced them to study chemistry in senior high school. Positive responses by gender for each year are shown in Figure 2. Overall, 33% of male senior high school chemistry students who responded to the survey indicated that the SEC influenced their decision to take this subject. This was the case for 38% of female chemistry students. Again, this difference was statistically significant, X^2 (1, N = 3,259) = 7.22, p = .007. Examination of responses to this question by year cohort indicates that there has been little change in the proportion of female students influenced by the SEC to take chemistry over time. There is, however, an increasing trend in the number of male students who identified program participation

Table 2. High School Student Survey Summary		Frequency	Percent
Gender	**Male**	2,833	54.4
	Female	2,371	45.6
Did the SEC provide appreciation of STEM careers?	**Yes**	3,396	65.2
	No	699	13.4
	System Missing*	1,115	21.4
Did the SEC influence your decision to study physics?	**Yes**	1,534	29.4
	No	1,419	27.2
	System Missing*	2,257	43.4
Did the SEC influence your decision to study chemistry?	**Yes**	1,148	22.0
	No	2,115	40.6
	System Missing*	1,947	37.4
Did the SEC influence your decision to study mathematics?	**Yes**	1,560	29.9
	No	3,304	63.4
	System Missing*	346	6.7
Did the SEC provide appreciation of science and engineering courses?	**Yes**	982	18.8
	No	88	1.7
	System Missing*	4,140	79.5

* System Missing items indicate students who did not complete the question because they were not studying physics/chemistry/mathematics/science and engineering, respectively, in Year 11.
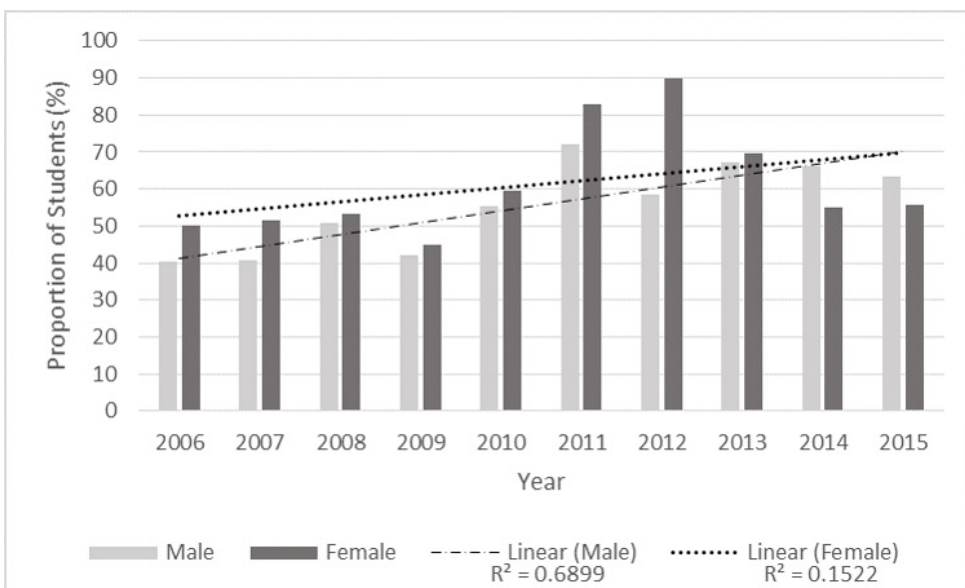
Figure 1. Students Influenced by SEC to Study Physics by Gender and Calendar Year
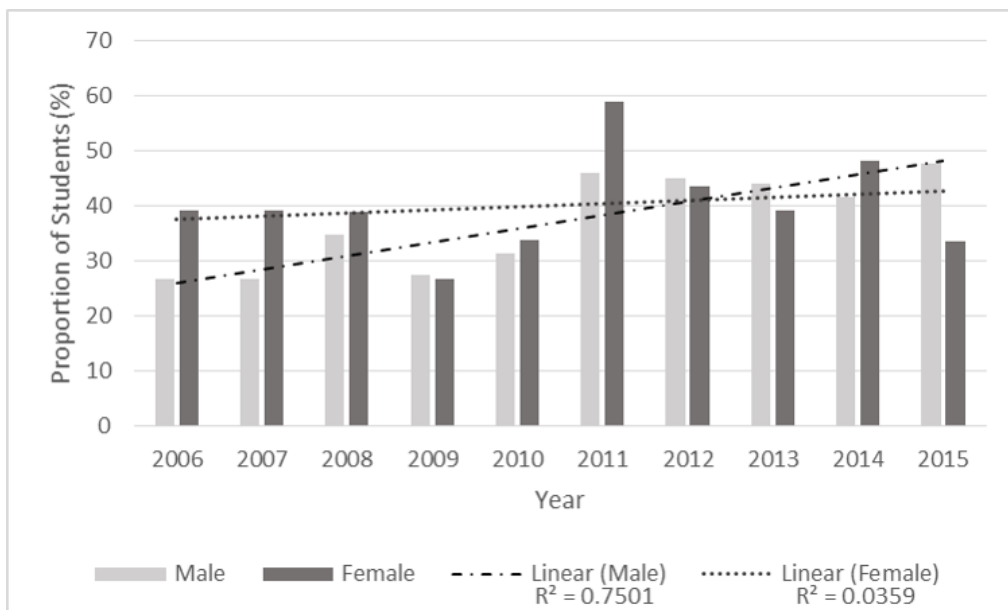
Figure 2. Students Influenced by SEC Participation to Study Chemistry by Gender and Calendar

as a factor that influenced their decision to study chemistry. It should be noted that the R^2 values for the generated linear regression models for male and female students were 0.7501 and 0.0359, respectively.

Of the students enrolled in mathematics, 32% indicated that participation in the SEC influenced their decision to take this subject in senior high school. This proportion of students is statistically significant, X^2 (1, N = 4,858) = 624.14, p < .000. Unlike students enrolled in chemistry and physics, there was no statistically significant difference in rate of positive responses between males and females, X^2 (1, N = 4,858) = 0.80, p = .365. Yearly positive response rates for male and female students are shown in Figure 3. It should be noted that in 2011 a large proportion of students, 53%, identified participation in the SEC as influential in their decision to study mathematics.

Students found the SEC rewarding, with 92.9% responding positively. This proportion, when tested using the Pearson chi-square nonparametric test, was statistically significant, X^2 (1, N = 5,184) = 3813.06, p < .000. Further, students surveyed from 2006 to 2011 inclusive were asked whether they felt that the SEC provided information about "the practical aspects of science and engineering careers." In total, 83% of students who answered this question responded positively, and this response was statistically significant, X^2 (1, N = 4,095) =

1776.27, p < .000. There was no significant difference between the proportion of male and female students who felt the SEC program offered an understanding of science and engineering careers (p = .959). From 2012 onward (n = 1,070), students were instead asked if the SEC program provided them with an "appreciation of the practical aspects of science and engineering courses." Here, 92% of students responded positively, a statistically significant proportion, X^2 (1, N = 1,070) = 746.95, p < .000. Again, there was no significant difference between the proportion of male and female students who felt that they had gained valuable information regarding science and engineering courses from SEC attendance (p = 0.216).

Student responses to the open-ended question "Do you have any comments to make about your experiences with the Science and Engineering Challenge?" were largely positive, with 1,113 comments coded as positive and 84 as either negative or neutral. Student comments were further analyzed and classified by theme. The majority of comments were about student enjoyment of the SEC program. The top five identified themes were enjoyment (n = 343), informative/learning experience (n = 179), constructive criticism of the program (n = 116), rewarding experience (n = 107), and positive effect on career/study choices (n = 93).

Specific examination of comments relating to career or study choices shows that
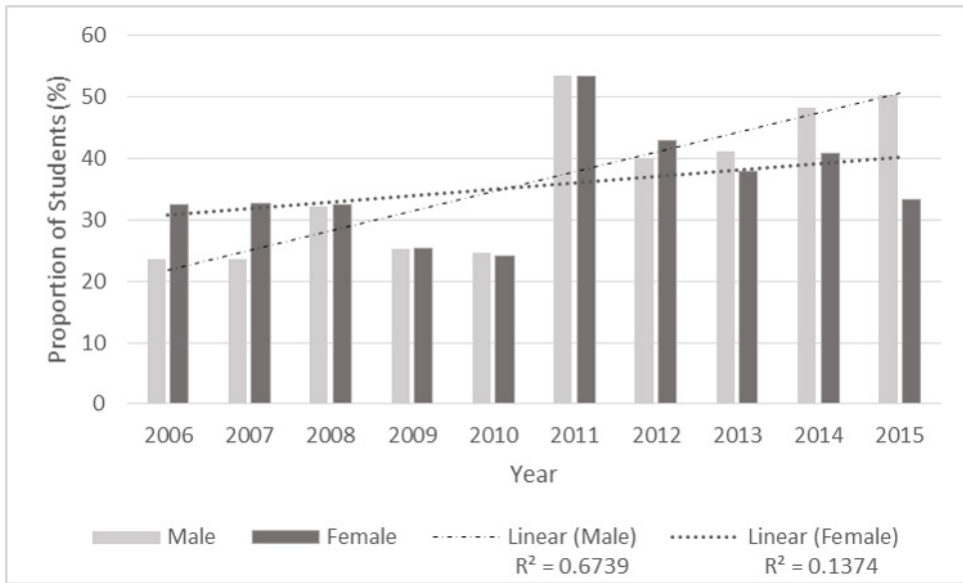
Figure 3. Students Influenced by SEC Participation to Study Mathematics by Gender and Calendar

students more often identified a positive effect than no effect. In fact, a positive effect was identified in 92 student responses, whereas no effect was identified by 33 students. Examples of comments that indicated a positive effect included "[the SEC] made me want to learn more in Math and Chemistry and Physics," "[the SEC] was very influential towards my decision to take up Chemistry," and "[the SEC] made me realise I want to be an engineer."

The UON Commencing Student Survey

In this section we present a summary of relevant data from the survey (see Table 3) as well as a detailed analysis of associations between the different variables.

Of the students who participated in the CSS, 458 (18.7%) had participated in the SEC program during high school; the remainder had either not participated or were unable to recall. It should be noted that survey participation was voluntary, and the average response rate was 25.1%; the number of commencing students who had participated in the SEC was approximately 1,800. Examination of student proportions from each faculty (Figure 4) revealed a greater proportion of students enrolled in the Engineering faculty (31%) that had attended the SEC than in any other faculty. This difference was statistically significant, X^2 (1, N = 1,070) = 746.95, $p < .000$. Furthermore, there was a statistically significant greater proportion of students who had attended the SEC enrolled in the Engineering, Science and IT, and Health faculties than in the Business and Law and Education and Arts faculties, X^2 (1, N = 2,445) = 10.60, p = .001. Across the faculties there was no statistically significant difference between the proportion of students who did or did not recall whether they had attended the SEC during high school ($p > .05$). Statistical significance was determined by comparing column proportions in a custom table and adjusted for all pairwise comparisons using the Bonferroni correction.

Of the students who had attended the SEC, 37.8% indicated that this outreach program had influenced which subjects they selected to study in their senior high school years. This proportion was statistically significant, X^2 (1, N = 458) = 27.39, $p < .000$. This influence was observed equally among ATSI and non–ATSI, as well as NESB and ESB students (p = .92 and p = .27, respectively). Not surprisingly, students enrolled in the Business and Law faculty were the least likely to indicate that participation in the SEC had influenced their subject decisions in senior high school. Students enrolled in the Faculty of Engineering as well as the Faculty of Health were the most likely to say that participation in the SEC had impacted their senior high school subject selections, with 51% and 43% of students, respectively, indicating as such.

The SEC had a lesser, but still statistically significant, impact on commencing stu-

Table 3. UON Commencing Student Survey Summary		Frequency	Percent
Gender	**Male**	709	29.0
	Female	1,736	71.0
Aboriginal or Torres Strait Islander Status	**ATSI**	59	2.4
	Not ATSI	2,386	97.6
NESB status	**NESB**	41	1.7
	Non–NESB	2,361	96.6
	Not disclosed	43	1.7
Participation in SEC	**Yes**	458	18.7
	No	1,755	71.8
	Don't Remember	232	9.5
Did participation in SEC influence senior study decisions?	**Yes**	173	7.1
	No	285	11.7
	System Missing*	1,987	81.3
Did participation in SEC influence decision to study science or engineering?	**Yes**	88	3.6
	No	370	15.1
	System Missing*	1,987	81.3

* System Missing items indicate students who did not complete the question because they had not participated in the SEC.
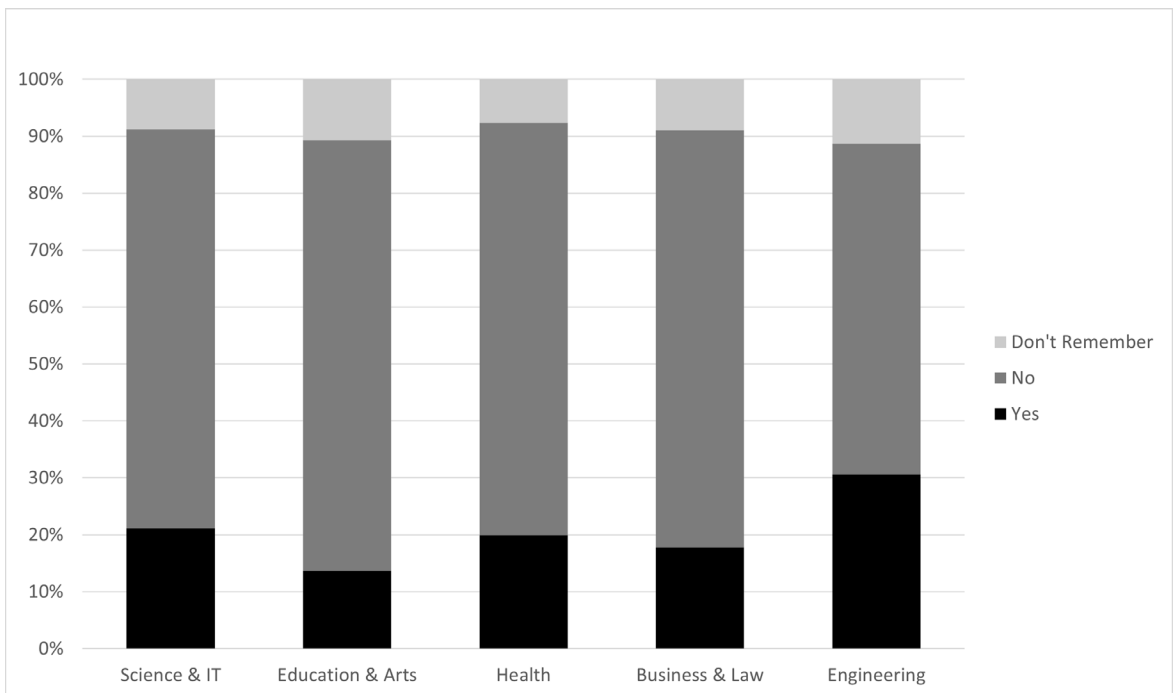

Figure 4. Proportion of Students Who Had Participated in the SEC During High School by Faculty

dents' decision to study specifically at the UON, with 21.6% acknowledging an effect, X^2 (1, N = 458) = 147.60, p < .000. The SEC had a greater influence on students' decision to study science and engineering courses at a university level. In fact, students enrolled in the Science and IT, Health, and Engineering faculties indicated that this was the case. This proportion was statistically significant, X^2 (1, N = 458) = 8.69, p = .003.

Further examination of student responses to the question regarding the influence of the SEC revealed that a greater proportion of students responding positively (46%) were enrolled in the Faculty of Engineering. Comparison of responses regarding influence to study science and engineering at university level by gender revealed a greater proportion of positive responses among male students, X^2 (1, N = 458) = 9.30, p = .002. Male students were more than 1.5 times more likely to identify the SEC as influencing their decision to study science or engineering at university.

Student responses to the open question "Is there anything else you would like to tell us about how the Science and Engineering Challenge affected your decisions about your career or study options?" were coded inductively for common themes. The most frequently identified theme was enjoyment, with 40% of comments including this theme (n = 48 out of 114). Such comments included "seeing the physical application made it seem more interesting to study such courses," "[the SEC] was an EXCELLENT opportunity for applying practical experience and really engaged me in science," and "[the SEC] made me realise how much I enjoy the construction process." The next most populated categories were positive impact on career or study, followed by no impact on study or career. Only one student commented that participation in the SEC program had a negative impact on his/her decisions about career or study.

Discussion

Many student responses to both surveys indicated that participation in the SEC had a positive influence, initially on high school subject selection, and subsequently on degree selection at university. Surveying students one year, and then at least 3 years after participation, enabled the measurement of self-reported outcomes rather

than aspirations. Further, the results of this study corroborate, and in some cases surpass, those presented by Husher (2010), who examined the efficacy of the SEC at an earlier stage in its evolution using a smaller sample.

High School Subject Selection

Of the students who participated in the HSSS and were enrolled in either physics, chemistry, or mathematics, 51.9%, 35.2%, and 32.0%, respectively, reported that their decision to study these subjects in senior high school was influenced by participation in the SEC. These proportions of students are notably higher than the proportions reported by Husher (2010), who found, 12 months after participation, that 36.2%, 11.8%, and 20.6% of students self-reported that the SEC influenced their decision to enroll in physics, chemistry, and maths (general and advanced), respectively.

Interestingly, both the results of the present study and those presented by Husher (2010) showed that students enrolled in physics were more likely to indicate that the SEC influenced their subject selection than those enrolled in mathematics or chemistry. This correlates with the learning environment presented by the SEC, where many of the activities have a strong focus on engineering and physics.

When first-year university students were surveyed in the CSS, 37.8% responded that participation in the SEC had influenced their subject selection in senior high school. Not only was this proportion statistically significant (p < .05), it was also similar to the proportion of high school students who had indicated that the SEC had influenced their decision to study chemistry or mathematics. This suggests that the influence of SEC participation remains not just 12 months after participation, but 3 or more years later when students have enrolled at university. These results support those previously reported where 34% of surveyed first-year undergraduate students reported that participation in the SEC influenced their decision to study science in senior high school (Husher, 2010).

Similarly, an independent study of the opinions of Queensland school students revealed that although personal factors and social factors were the most influential in Year 11 and 12 subject selection, participation in extracurricular activities played an

important role during the early stages of subject selection (Whiteley & Porter, 1998). Internationally, studies have also identified extracurricular activities as playing an important role in student decision-making, particularly in relation to the selection of STEM subjects (Henriksen, 2012; Henriksen et al., 2015). Compared to the 80% of summer science camp participants surveyed by Markowitz (2004) who indicated that the camp had contributed to their subsequent pursuit of a science career, the proportion of university students who responded that the SEC had influenced their decision to undertake a STEM degree is much smaller. However, comparison between these two studies should be viewed with caution as the studies had vastly different sample sizes and are very different. The program evaluated by Markowitz was a merit-based summer camp that focused specifically on science, and therefore presented a very different learning environment from the SEC. In addition, Henriksen et al. (2015) found that targeted STEM recruitment programs affiliated with universities had the greatest impact on study decisions when participation coincided with major educational decision points. This suggests that the SEC could have a greater impact on the senior subject selection of students who attended in Year 10 rather than Year 9.

STEM Degree Selection

A statistically significant number of students who were enrolled in the Faculties of Engineering or Science and IT indicated that participation in the SEC during high school had later influenced their decision to study in these disciplines. In fact, the proportion of students who responded this way (30.9%) was similar to the one third of students who self-reported that the SEC influenced them to undertake study in their current STEM degree in Husher's (2010) earlier study. This is slightly higher than the proportion of students, 25%, who identified STEM outreach programs as an important or very important factor in educational decision-making in a study of Australian university students by Lyons and Quinn (2013).

These figures indicate that, of students who participated in the SEC and subsequently pursued further study in STEM fields (whether in senior high school or at university), approximately one in three identified the SEC as a factor that influenced their study choices.

Examination of HSSS results highlighted the role of the SEC in providing career and study information. An overwhelming majority of students indicated that the SEC provided information not only about the practical aspects of science and engineering courses at university (92%), but also about subsequent careers (83%). Furthermore, examination of student responses to the open-ended question revealed that a substantial number of students (n = 92) expressed—in their own words—that the SEC influenced their study and career decisions. This number is approximately three times the number of students whose responses indicated that the SEC did not affect their career or study choices. A similar trend was observed in the comparable open-ended question in the CSS, where the second most common theme was the positive impact of the SEC on study and career choices. Together, this information suggests that the SEC may provide career information in a format that is accessible and understandable for most participating students and that this information influences a significant proportion of these students to further pursue STEM study and careers. It is very difficult to ascertain whether these students would have chosen a STEM degree if they had not participated in the SEC. However, their specific mention of this outreach program as an influence in their decision indicates that at least they recognized it several years after their participation as something they enjoyed and somewhat affecting their career path.

The self-reported influence of the SEC is representative of the positive correlation between attending STEM outreach events and increased student knowledge of and interest in STEM careers reported in the literature. For example, Dabney et al. (2012) contended that students who participated in STEM outreach were, on average, 1.5 times more likely to demonstrate interest in STEM-related careers than students who did not participate in these activities. Another study that evaluated the impact of a single STEM outreach activity, the NSEW Science Extravaganza in Manchester, found that when asked, 82% of students said that the event provided them with information about STEM-related university degrees, and 46% claimed that their participation increased their interest in pursuing a STEM career (Illingworth et al., 2015).

The SEC and Groups Underrepresented in STEM

Comparison of positive response rates (indicating that SEC participation had influenced senior high school subject selection) between male and female students revealed a notable difference. Overall, female chemistry and physics students were more likely to identify the SEC as a factor that encouraged them to study these subjects in senior high school. This finding is similar to that from previous research by Nadelson and Callahan (2011), who found that female secondary students were more likely to be positively influenced by science outreach programs.

It is clear from our analyses that earlier instances of the SEC were more successful at encouraging female than male participation in senior STEM subjects; however, this difference is less evident in more recent years. For both chemistry and physics, the linear trends generated were more descriptive of the variation in positive response rate for males. We speculate that a more comprehensive STEM outreach environment targeting young women means that the SEC may no longer be the first experience of nonschool STEM for female students, particularly in rural and remote areas.

The gender difference in the likelihood of the SEC influencing decisions to pursue STEM subjects and careers is not evident when students commence tertiary studies. The CSS results indicated that of those students studying in STEM faculties, there was no statistically significant difference between the proportion of male and female students who identified the SEC as an influential factor in their degree selection. This is consistent with findings from surveying students enrolled in science, technology, and engineering degrees across 29 Australian universities, where females were no more likely to identify STEM outreach programs as influential than their male counterparts (Lyons & Quinn, 2013).

The CSS showed that there was no significant difference between response rates of ATSI and non-ATSI students to questions regarding whether participation in the SEC influenced either senior high school subject selection or further study of science or engineering at university. Although the SEC does not specifically aim to increase STEM participation among ATSI students, it is deeply committed to addressing equity issues. For example, in 2015 the SEC worked

with rural and remote communities, professional groups, industries, and businesses in the Northern Territory and Western Australia to set up the Australia North West Tour. This highly successful tour allowed students in remote communities like Alice Springs, Katherine, Derby, Broome, Port Headland, Tom Price, and Karratha to participate in the SEC. Across this tour an average of 22%, and as high as 68% in one remote region, of the 1,780 participating students identified as ATSI.

Limitations

The design of the surveys used in the study provided a few challenges for data analysis and interpretation. The survey, designed for quality assurance rather than research, included leading questions. The decision to phrase questions in this way was made to simplify the coding process rather than to solicit favorable results. Students may have felt that it would be perceived favorably by the university to answer positively about their enjoyment and the career influence of the SEC.

The response rate among students for the HSSS could not be determined. It is estimated that over 150,000 high school students participated in SEC events between 2006 and 2015, but only 5,210 students (3.5%) responded to the survey. It is unclear how many students were afforded the opportunity to complete the survey, as distribution required cooperation from teachers and principals 12 months or more after participation in the SEC. Perhaps students who completed the HSSS survey did so because they felt more positively about their participation in the SEC. Another mitigating factor to consider was that the HSSS survey was taken 12 months after participation, so some students may have changed schools in this time and therefore not had the opportunity to participate in the HSSS. The average response rate for the CSS was 25.1% over the 3 years. Participation in both surveys was on a voluntary basis, so nonresponse bias should be considered when interpreting the results.

Further, since primarily dichotomous questions, rather than Likert scales, were used in the surveys, there was no way to quantify the extent to which the SEC influenced students' decision to study STEM, either at university or in senior high school. For future evaluation of the SEC program, the use of scaled responses, pre- and postas-

sessment, as well as examination of Year 11 STEM subject enrollment rates in schools that participated in the SEC, will be considered.

Conclusions

Research examining student interest and success in STEM indicates that STEM outreach programs are part of a dynamic and complex learning ecosystem in which "educators, policy makers, families, businesses, informal science institutions, afterschool and summer providers, higher education, and many others [work] towards a comprehensive vision of . . . STEM learning for all children" (Traill & Traphagen, 2015, p.1). Further, STEM outreach programs have been shown to be just one of many factors that may affect student decision-making in relation to study and career aspirations (Archer et al., 2013; Henriksen, 2012; Henriksen et al., 2015). This complex interplay between different factors makes evaluation of a single program challenging.

Although the complexity of STEM learning ecosystems presents numerous barriers to evaluation of STEM outreach programs, research in evaluability of assessment shows that it is possible to ensure that precon-ditions that enable evaluation of outreach programs exist (Trevisan, 2007). Indeed, outreach programs have the potential to be evaluated as long as they "assess the extent to which measurable objectives exist, whether these objectives are shared by key stakeholders, whether there is a reasonable program structure and sufficient resources to obtain the objectives, and whether program managers will use findings from evaluations" (Trevisan, 2007, p. 291). However, many outreach programs start their journeys before these considerations are put in place. The research presented in this article demonstrates that such evaluation is still possible. Here we have demonstrated that secondary analysis of retrospective survey data can be used effectively to assess the longer term self-reported impact of participation in the SEC on students' study choices. The results, although painting a very positive picture of the program, highlight areas where the evaluation could be improved. We believe our research contributes to building a knowledge base for effective evaluation of STEM outreach, which is essential not only for continued program development but to guide future investment in such programs (Devi et al., 2016).

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Appendix A

High School Student Survey (HSSS)

Have you participated in the Science and Engineering Challenge?
_____ Yes
_____ No

Are you in year 11 or 12?
_____ Yes
_____ No

If you answered YES to both of these questions, help us build a better Challenge for all students by completing this online survey—it only takes 5 minutes!
_____

1. Did you participate in the Science and Engineering Challenge in the last 2 years?
_____ Yes
_____ No

2. Gender
_____ Male
_____ Female

3. In which school year are you enrolled?
_____ Year 11
_____ Year 12
_____ Other (please specify)

4. Did you find the Science and Engineering Challenge a rewarding activity?
_____ Yes
_____ No
_____ Not Applicable

5. Did the Science and Engineering Challenge give you an appreciation of the practical aspects of science and engineering courses?
_____ Yes
_____ No
_____ Not Applicable

6. Are you currently enrolled in the following?

	Yes	No
a. Physics	_____	_____
b. Chemistry	_____	_____
c. Mathematics	_____	_____

7. Did the Science and Engineering Challenge influence your decision to study?

	Yes	No	Not Applicable
a. Physics	_____	_____	_____
b. Chemistry	_____	_____	_____
c. Mathematics	_____	_____	_____

8. Do you have any comments to make about your experiences with the Science and Engineering Challenge?
_____

Thank you very much for taking the time to complete this survey.

Note that prior to 2012, Question 5 asked students whether the Science and Engineering Challenge provided them with an "appreciation of the practical aspects of science and engineering careers."

Appendix B

The University of Newcastle's Commencing Student Survey

SEC1. Did you participate in the Science and Engineering Challenge while you were at school?
_____ Yes
_____ No
_____ Don't remember

SEC2. Did your participation in the Science and Engineering Challenge influence your decision to study Physics, Chemistry or Mathematics in the final two years of secondary school?
_____ Yes
_____ No

SEC3. Did the Science and Engineering Challenge influence your decision to study at the University of Newcastle?
_____ Yes
_____ No

SEC4. Did the Science and Engineering Challenge influence your decision to study Science or Engineering at the University of Newcastle?
_____ Yes
_____ No

SEC5. Is there anything else you would like to tell us about how the Science & Engineering Challenge affected your decisions about your career or study options?

The Benefits of University Collaboration Within University–Community Partnerships in Europe

Primož Medved and Matjaz Ursic

Abstract

This article demonstrates and explains the benefits accruing to communities that involve universities in their local community-based projects from the context of community-based work taking place in Europe. We include concrete arguments intended to stimulate the transfer of the universities' accumulated knowledge to local (urban) community projects in order to overcome the challenges of contemporary cities. A multiple case study analysis of relevant university–community partnership (UCP) projects in Europe is used to provide evidence for the value of urban community–university partnerships. This article as a whole represents an attempt to bring to light the considerable potential of universities, which should extend their focus (metaphorically and physically) outside the purely academic sphere and magnify their capabilities within local university–community partnerships.

Keywords: university community partnership (UCP), community-based projects, EU community engagement, urban planning

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One of the major challenges facing universities today is the identification of the most adequate approach to (re)activating their relevance within local urban contexts in order to solve the concerns of contemporary local communities (Ishisaka et al., 2004). Bok (1990) and Votruba (1996) advanced the idea that the detachment of universities from local urban communities has distanced these institutions from local sources of creativity, which adversely affects indispensable academic dynamism. Wievel and Knaap (2005) recognized the university as a crucial stakeholder that could and should ameliorate city environments with the active involvement of local communities. Similarly, Boyer (1996) saw the university as the main actor able to resolve current social, civic, economic, and moral problems faced by society.

The process of building sustainable long-term, enduring partnerships between universities and local (urban) communities is still far from complete. In recent years, however, there has been a reemergence of the more persistent transfer of universities' expertise from the traditional campuses back to "real life" neighborhood environments. Today, it is possible to recognize that universities are cooperating with an increasing number and variety of communities (Jongbloed et al., 2008). Recent decades have seen an increase in the formation of long-term partnerships between universities and communities in order to address multiple social challenges (Strier & Shechter, 2016). Universities' revitalization efforts can activate a neighborhood and are especially beneficial if they are centered on community engagement and local volunteerism (Ehlenz, 2019).

A cooperative effort wherein the independent character of the university is manifested in the form of participation with local communities is often defined as a *university–community partnership* (UCP). The umbrella term "university–community partnership (UCP)" is used in academic journals to describe any endeavor in which universities and local communities are mutually involved (Lewis et al., 2016). According to Eckerle Curwood et al. (2011), UCPs can be defined as "collaborations between community organizations and institutions of higher education for the purpose of achiev-

ing an identified social change goal through community-engaged scholarship that ensures mutual benefit for the community organization and the university" (p. 16). University–community partnerships have also been described as "the coming together of diverse interests and people to achieve a common purpose via interactions, information sharing, and coordination activities" (Jassawalla & Sashittal, 1998, p. 239). Yassi et al. (2010) defined the university–community partnership as a form of academic outreach and community engagement in the service of addressing local community problems. These partnerships are characterized by long-standing commitment, comprehensiveness, shared planning, mutuality, and so on (Butcher et al., 2011; Strier, 2014). UCPs can also be understood as an experiment to determine what can be expected from collaborations among faculties, community activists, and other actors (Baum, 2000) and could eventually lead to a more meaningful and stable relationship rather than simple coexistence (Miller & Hafner, 2008).

University–community partnerships are driven by the achievement of mutual goals (Strier, 2011). *Mutuality* represents a common foundation or basis for most UCPs. A mutually beneficial, respectful partnership between the university and urban community represents the basis for planning communal urban project developments (Gilderbloom & Mullins, 2005; Perry & Wievel, 2005; Wievel & Knaap, 2005). UCP could represent an ideal formation that could amplify the mutual, reciprocal benefits through colearning and collective problem-solving. Enos and Morton (2003) claimed that such partnerships would not only change the individuals involved but also spread their influence into the community at large. The way the community will be considered and involved within universities' educational practices will significantly affect the skills, behaviors, and civic knowledge that students learn (Bakko & McBride, 2017).

The universities should recognize and value the expertise of people outside academia, especially as coproducers of knowledge. Universities should especially incorporate the voices and knowledges of marginalized communities in order to help and listen to the "unseen" part of society (Duncan et al., 2014; Kagan & Diamond, 2019). Universities should apply communities' intellectual resources toward societal needs (Kagan & Diamond, 2019).

Communities (within UCP) have a strong and heterogeneous impact on universities. First of all, community members could teach at the university and show how the theoretical frameworks actually work in practice. Therefore, UCP could represent a powerful method or facilitator to help teach traditional subjects in a more personal and applicable way. At the same time, it represents an ideal setting for students to associate their coursework on civic life with an authentic civic experience (Daynes et al., 2003).

For university students, there are numerous benefits to working with the community. Students can come to understand how to work for mutual benefits and shared goals, acquire knowledge regarding social issues, develop skills to build consensus, and reflect on their identity and personal growth in the partnership context (Bakko & McBride, 2017). Coworking with the community activates the students' real-world learning. Important and often underestimated components and consequences of UCP represent the effects of understanding social issues, personal insight, and cognitive development (Bakko & McBride, 2017).

Obviously, university–community partnerships are based and take place predominantly in the neighborhoods where the community members live. Through fieldwork students can experience different social activism approaches and personally participate in the community-building process (Kaufman, 2004). Field education (within UCPs) allows for a better exchange of information between academic institutions and their communities (Wertheimer & Sodhi, 2014).

On the other hand, the university as a partner within the framework of a UCP could bring a variety of valuable resources, including faculty academics with research expertise, excellent libraries, knowledge dissemination strategies, and more (Dulmus & Cristalli, 2011). Ferman and Hill (2004) identified four principal incentives for partnering with higher education researchers: obtaining project-related resources, leveraging further resources, gaining access to networks, and increasing legitimacy.

Allen-Meares (2008) has put forward the idea that universities also have a moral duty

to cooperate with local (urban) communities. Similarly, Buys and Bursnall (2007) agreed that universities are committed to reacting to the growing social needs of the local communities. "Community engagement is more than a structural manifestation, essentially, it is a philosophical belief that can help evolve, shape, and progress higher education for local, national and international communities" (Bernardo et al., 2012, p. 191). The main challenge is to bring the university back to the "real-world" environment more consistently and systematically in order to solve the challenges faced by local communities in a cooperative manner.

UCP Challenges and Research Goals

Challenges

After defining "university–community partnerships" (UCPs), it could be understood that it is common and customary for a university to be involved and participate in local community projects. Currently, however, universities interact predominantly with their traditional stakeholders, such as students, researchers, and funding organizations (Jongbloed et al., 2008). Although relevant examples of constructive collaborations exist, in general universities and their adjacent local communities rarely work together to address common concerns (Martin et al., 2005).

Several factors account for this "unaccomplished" cooperation between universities and local communities. First, universities usually benefit more than local communities from UCPs, which can provoke a sense of resentment and mistrust (Strier, 2014). Second, according to Miller and Hafner (2008), unequal distribution of power represents one of the greatest barriers to successful cooperation between universities and local communities. Universities are usually better funded and more powerful than local communities, which at times allows them to steer the UCP agenda (Strier, 2011). University representatives are sometimes recognized as dominant and might not adequately consider the needs of the local communities (Miller & Hafner, 2008; Shamblin, 2011). These unequal balances of power could cause tension over proprietorship, funding, and control and affect sustainability (Strier, 2011). Third, a significant barrier is the university's image as an elitist institution sometimes discon-nected from reality. Universities are often perceived as elitist and academic research as an exclusive domain (Strier & Shechter, 2016). According to Martin et al. (2005, p. 3), "Universities promoted themselves as elite bastions of information and knowledge." During a significant part of the 20th century, universities focused predominantly on research and publication, and their primary mission was to create an educated class of leaders (Wilson, 2004). Fourth, according to Eckerle Curwood et al. (2011), the modus operandi of universities has not yet adapted to be fully immersed in sustainable community partnerships. The administrative structure of some universities was not intended or formed to maintain long-term community engagement. An increase in the university's willingness to engage in community partnerships is crucial. Apart from those previously mentioned, Strier (2014) identified several other barriers that limit the effectiveness of UCPs, including competition over resources, different value systems, conflicts of interest, bureaucratic restrictions, a lack of adequate planning or implementation, absence of continuing evaluation procedures, and gaps in starting knowledge or experience. As Walsh (2006) affirms, the dissimilarity between the structure of universities and local communities can provoke irresolvable conflict, and it is therefore necessary to present several best practices that encourage and support the implementation of effective UCPs.

Research Goals

The abovementioned challenges could represent the main reasons that UCPs are still not currently more widespread in cities. Obviously, UCPs could bring benefits to both factions—the local community and the university. However, it has been identified that local (urban) communities are often skeptical and thus unwilling to participate with universities in such partnerships. The general, broad aim of this article is to demonstrate and explain why it is beneficial and advantageous for local communities to involve universities in their local community-based projects and why the university can be of use in local projects. The goal is to propose suggestions and arguments that could stimulate the transfer of the universities' accumulated knowledge and know-how to local (urban) community projects in order to overcome the challenges found in contemporary cities, especially in relation to "place" and spatial planning. The main

objective of the article is to show local communities the "university added value," not from abstract models or academic debates, but as demonstrated in already implemented UCP best-case studies. This article sheds light on the hidden innovative elements of UCP projects that might serve as a font of inspiration for future UCPs.

Methodology

Through a scientific literature review it was possible to see that universities' potential contributions to UCPs have often been presented in too theoretical a manner, as an abstract proposition, or have been based on a small number of case studies and rarely (e.g., Lerner & Simon, 1998) on a wider examination of several UCP experiences. We wanted to use an evidence-based method to explicitly and concretely answer the question "Why is it recommended to involve the universities in local community-based projects?" Hence, for this article, which is based on a particular research framework, we carried out a comparative analysis of 11 recognized and successful UCP projects; most of these were implemented by the members of the Urban Education Live project consortium.

Five different international team members participated in the Urban Education Live (UEL) EU project. Three were from academic spheres—the University of Sheffield (UK), the University of Ljubljana (Slovenia), and the Tampere University of Technology (Finland)—and two were NGOs: Institute for Spatial Policies – IPoP (Slovenia) and Urban Transition Association (Romania). Each of the five consortium partners has been involved in several distinguished national and international university–community partnership projects, which we analyze in this article. The consortium teams, and consequently the analyzed case studies, are well balanced in terms of expertise (urban sociologists, architects, anthropologists, environmental economists, etc.) and in terms of geographic location (north, east, west, and south EU), which allows the formulation of a comprehensive overview of today's challenges and opportunities within European university–community partnerships. The Urban Education Live consortium has focused its research on several research pillars, and within the pillar "new role of the university" we identified and highlighted new original perspectives of the evolving relationship between the university and the local urban community within a UCP. Via case study analysis of contemporary UCP projects, the article highlights how the university is linked and activated within different local urban communities in Europe.

With the establishment of a research framework with unique UCP research focal points (see Figure 1), which were transmitted to a specially written questionnaire, we were able to identify a variety of constructive contributions that universities have provided to recent UCPs. In total we analyzed and compared 11 UCP projects. Short descriptions of case studies are presented in Table 1. The comparative analysis of the case studies is based on five UCP research focal points: (a) *the university as activator*, where we examined if, how, and where the university performed the role of "activator" for creative (innovative) urban processes; (b) *new context*, where we researched the advantages of establishing working hubs in new social contexts, using new locations in the city rather than traditional university campuses; (c) *university expertise*, where we identified why it was important that the university was involved in the project, and how a specific university's expertise contributed to the fulfillment of the project; (d) *the university's independent character*, where we explored how the university's independent character represented a major asset in facilitating the implementation of the specific project; and (e) *the community's effect on the university*, where we investigated how the projects influenced the university, resulting in new curricula, new pedagogy, new contacts, the production of new types of data, and so on. This new set of UCP research focal points was transferred to the main questionnaire, the analysis of which represented the empirical basis for our methodological research process. Each questionnaire had 51 open-ended questions. We used the content/thematic analysis method to analyze the questionnaires' answers.

It was essential for the purpose of the article that in seven out of the 11 analyzed case studies (see Figure 1, Step 3) the questionnaire was answered by the actors (consortium partners) who were actively involved in the projects ("Internal case studies"). The "direct data accumulation" allowed us to obtain accurate and authentic inside perspectives on the cases. The research focal points expressed in the questionnaire enabled participants to rethink past projects
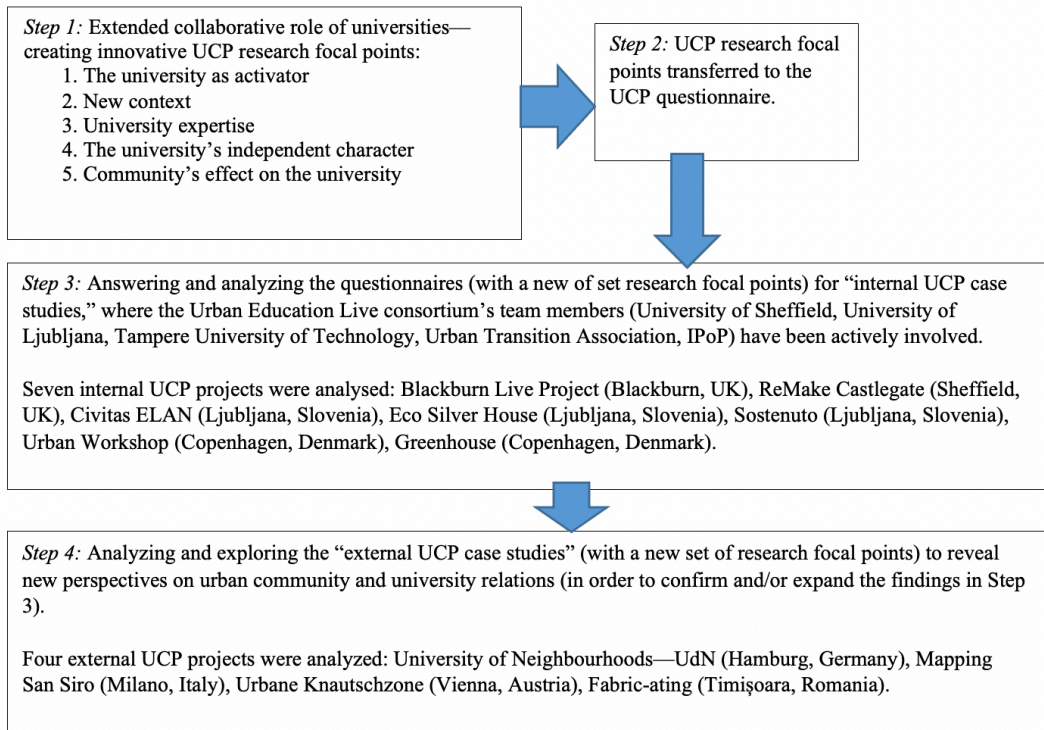
Figure 1. Methodological Process

Table 1. Descriptions of the UCP Case Studies		
Projects *(Duration, location)*	**Partners Involved**	**Mission / Description**
A. Blackburn Live Project 2013–2016 Blackburn (England)	University of Sheffield, Blackburn with Darwen Borough Council, Blackburn Is Open, Creative Lancashire	The various collaborations focused on exploring the connectivity between social and creative infrastructure in Blackburn, and developing upon Blackburn's existing creative town plan; exploring the role that arts and the creative industries could play in rejuvenating Blackburn town centre.
B. Civitas ELAN 2008–2012 Ljubljana (Slovenia)	Cities: Ljubljana (Slovenia), Gent (Belgium), Zagreb (Croatia), Brno (Czech Republic), Porto (Portugal). In Ljubljana: 11 local partners (local NGOs, University of Ljubljana, research institutes)	"Mobilize" citizens by codeveloping clean mobility solutions for vital cities, ensuring health and access. Special attention was devoted to the aspect of inclusion and participation of the public in the implementation process. The core activity in Ljubljana represented the introduction of environmentally friendly, fast, reliable, and safe public transport on the corridor named "Dragon's tail."
C. Eco Silver House 2013–2016 Ljubljana (Slovenia)	10 research institutions (from Slovenia, Austria, Sweden)—including University of Ljubljana, industry partners	The overall objective of the project was to demonstrate and validate new technologies, concepts, and systems for sustainable, low-energy building in order to test and assess the technological, economic, and social feasibility of innovative energy solutions in the high-rise multiresidential building Eco Silver House.

Table 1. Descriptions of the UCP Case Studies *cont'd*		
Projects (*Duration, location*)	**Partners Involved**	**Mission / Description**
D. Fabric-ating 2014–2015 Timișoara (Romania)	Local NGOs, West University of Timișoara, Shakespeare High School, Fabric Consultative Neigh. Council, Timișoara Municipality, The West University Student Association, Transformatori	The main goal of the project was to reclaim a series of underused public spaces across the neighborhood and to use them as a pretext for community engagement and for promoting active citizenship. The project represents an example of combining a top-down research-driven approach to the social and spatial characteristics of the area with bottom-up approaches characterized by interactions with local inhabitants.
E. The Greenhouse 2012–2013 Copenhagen (Denmark)	Supertanker/CiTyBee, Roskilde University, The municipality of Copenhagen	The aim was to map the intangible industrial heritage of Hedehusene and the tangible urban structure (buildings and other traces). This original goal was combined with an aim to experiment with new methods and develop a new processual approach to "strengthening local civic life."
F. Mapping San Siro 2013–still active Milan (Italy)	University "Politecnico di Milano," University "IUAV," University "La Sapienza"	The project aims to address the research of a peripheral degraded urban neighborhood through the direct participation of the local population. Mapping San Siro brought together a multidisciplinary group of students, teachers, and researchers, aiming to explore different forms of scientific knowledge production in order to stimulate dialogue with local communities.
G. ReMake Castlegate 2014–still active Sheffield (UK)	Friends of Sheffield Castle, Friends of the Old Town Hall, Sheffield City Council, CADS, Thrifty Store, BDP, TUoS, Sheffield University, etc.	To produce a vibrant and creative vision for the future of the area—working bottom up to build on existing heritage, enterprise, and social history, with the participation of the local community. Through Live Projects and Live Design Studios, more than 100 master's students have produced research projects and speculative designs that are relevant for the local area's future.
H. Sostenuto 2009–2012 Ljubljana (Slovenia)	Bunker (Slovenia), Citema (Italy), Expeditio (Montenegro), Relais Culture Europe (France), University of Valencia (Spain), Zunino e partner progetti (Italy)	Reinforcing the cultural sector's innovation capacity in the Mediterranean as a way to generate new social and economic models and boost competitiveness and sustainability in the Med. zone. Sostenuto is a pilot project carried out in four cultural labs in France, Italy, Slovenia, and Montenegro.
I. University of Neighbourhoods 2008–2013 Hamburg (Germany)	HafenCity University (HCU), IBA Hamburg, Kampnagel	Developing and testing contemporary forms of education at the crossover point between culture, knowledge, and urban development. Throughout this autonomous, experimental project set up by the Urban Design faculty (HCU), the themes and questions from the fields of education and research were being put into practice.

Table continued on next page

Table 1. Descriptions of the UCP Case Studies *cont'd*		
Projects (*Duration, location*)	**Partners Involved**	**Mission / Description**
J. Urban Workshop 2012 Copenhagen (Denmark)	Roskilde University, Citybee, local community of Hedehusene	Exploring the field of experimental urbanism encompassing concrete urban areas' challenges and actors. The goal was to develop open-ended, interactive skills for the individuation of urban challenges. A special focus of the project was dedicated to the methods for active involvement of locals through spatial interactions.
K. Urbane Knautschzone 2016–still active Vienna (Austria)	Social Design Arts as Urban Innovation; University of Applied Arts Vienna, Dérive—Association for Urban Research	The project shows that societal innovation with unexpected approaches becomes possible in the space where different forms of knowledge and methods interact. The interventions aimed to highlight and strengthen the neighborhood's potentials regarding cohabitation and community identity.

from a new perspective and to reformulate the processes and outputs for each project. These questionnaires were completed by individuals who had been actively involved in the respective UCP projects, giving an insider's perspective on UCP processes and outcomes.

The other four case studies (see Figure 1, Step 4) represent some of the most recognized and successful UCP projects in Europe. These four additional case studies, which were not performed by the consortium partners ("external case studies"), have been analyzed with the same theoretical framework (same research focal points) as the internal case studies. In order to respond to the questionnaires, empirical data for the external case study analysis was collected through secondary sources (articles, books, brochures, guides, webpages, etc.). With the analysis of the external case studies (Step 4), we wanted to amplify the research process in order to understand and analyze additional UCP experiences from various perspectives with the intention of obtaining some relevant, unusual, and unexpected elements and to eventually confirm and expand the findings from an analysis of our internal case studies (Step 3). Findings from the comparative analysis will enable us to indicate the benefits that universities could potentially bring to university–community partnership projects.

University–Community Partnerships—Case Study Analysis

In this section, the research of all 11 analyzed case studies will be highlighted using an analytical framework with key UCP research focal points (see Figure 1, Step 1). The UCP research focal points facilitated our investigation, wherein we particularly intended to emphasize the importance of university involvement in local urban neighborhood projects. Within the initial university–community partnership investigation, we identified five important UCP research focal points—(1) the university as activator, (2) new context, (3) university expertise, (4) the university's independent character, and (5) community's effect on the university—which represent the essence and the structure of the research process for our case study analysis (see Methodology section). The intention of this research structure is to accurately identify the mutual benefits of university–co mmunity partnerships, and in particular to highlight the contribution of the university—the "university added value"—in such partnerships.

The University as Activator of Creative Urban Processes

From the analysis of the UCP case studies it was possible to comprehend that the university's activator role is primarily shown within the fundamental function of the university or, rather, the aspiration of the university to become a cogenerator of innovation. In the project Sostenuto in Ljubljana, the University of Ljubljana started the flow of creative urban process, with other city partners and actors being gradually added. The university took the role of a cogenerator of conceptual frameworks, a terrain research unit, or a cocreator of a unique methodological platform within

the project by providing complex research methods for analysis in the field and at the same time by identifying and connecting relevant stakeholders for further activities. University engagement in local urban settings could activate the creative potential of the local community. Within the UCP case study Blackburn Live Project, the project's partners established a research hub in one of Blackburn town centre's vacant shops by arranging public consultations for what was called a "Making Session." In this UCP, it was possible to apprehend that the active involvement of the university could activate fresh thinking and innovative ideas in a local community–based project.

The university can transfer its capacities and knowledge into specific local contexts in order to "contaminate" the residents with new "working tools" that enable them to see their project from different viewpoints. In the UCP project Mapping San Siro, a program of teaching in the field allowed students to reflect on which outcomes are possible with the goal of academic utility—that is, benefiting students and teachers—and with the goal of social utility, benefiting the city and communities. University representatives encouraged direct interaction between activists, local actors, and researchers, who could all become equally involved in the production of knowledge. This "contamination of openness" is a perfect example of how the university encourages the creativity of all the actors involved. Several completed UCP projects (e.g., Greenhouse, Urban Workshop) highlighted the university's openness and freedom in research as key elements that enable exploration of often overlooked factors and discovery of unrecognized resources and voices.

In the project Sostenuto, it was possible to observe that knowledge and skills acquired by university students in debates and on-site visits promoted social dynamics between them and local residents enabling mutual learning. Another important feature that emerged in Civitas ELAN is represented by the university function *merger of knowledge platforms*. This integrative university characteristic is manifested through combining skills and knowledge of very different UCP project actors.

University Engagement in New Social Contexts and in New Locations Within the City

Most of the analyzed case studies demonstrated that it was beneficial for UCP projects to be performed in "real" neighborhoods, outside university campuses (or other forms of traditional university infrastructure). Partaking in a UCP project in the local community territory strengthens the relationships, collaboration, and trust between the local community, the university, and other actors. These benefits have manifested in various ways.

For example, locally performed projects are advantageous for university representatives because they enable students to be more directly involved with community members and have better access to informal networks—that is, they offer improved connections with local inhabitants. In the project University of Neighbourhoods, the creative approaches included artistic engagement, working with an orchestra, and special sharing mechanisms. The students learned from the neighborhood and came to understand local people's interests and use of space, which enabled them to further develop unique engagement techniques for the local area. In Blackburn Live Project, it was noted that the new university's physical settings in local neighborhoods made it much easier for students to establish contact, invite local people to join in their activities, and debate. In Mapping San Siro it was perceived that the teaching-in-the-field program allowed students to reflect on the social utility of project actions that could improve quality of life, particularly for local community members who live in a deteriorated urban zone.

Often UCP projects are performed in deprived neighborhoods characterized by strong sociospatial inequalities and intercultural or intergenerational conflicts; this was true for the projects Mapping San Siro and Urbane Knautschzone. Universities should prioritize such efforts and be more active in those neighborhoods that require more care and consideration. In Urbane Knautschzone, "working in the field" and being a "university satellite" gave researchers an opportunity to work in deprived peripheral areas in Vienna. Similarly, in the UCP project Urban Workshop, the declining suburban setting in which the students worked placed them outside the comfort zone of the creative class and forced them to be more aware of how to work, research, and be active in a nonacademic and non–inner city setting. Local communities in deprived neighborhoods are often forgotten by local

and national authorities. Participating in a UCP offers them an opportunity to be heard, to raise their voices and create a strategy for change, with the university's participation.

The collaboration with the community may also advance the spatial transformation of the urban fabric. In the UCP project ReMake Castlegate, local stakeholders, with university support, opened up and revived an abandoned city center building. The reclaimed space gave creative entrepreneurs, artists, individuals, and organizations an opportunity to test civic ideas in a valuable yet underused public city space on a temporary basis.

Finally, it is also important to mention that, as was demonstrated in the UCP project Sostenuto, a significant manifestation of university action in new urban locations represents the higher quality and more accurate data accumulation that results from direct contact with the locals in their territory (direct source of information).

University Expertise as a Crucial Asset for Project Performance

The university's specific (academic or research) expertise in the analyzed case studies is manifested in various ways. First, the university's ability to explore inventive methods and develop different implementation strategies is beneficial for every UCP. As was shown in Blackburn Live Project, the university can provide the support (time and resources) to develop speculative visions based on rigorous research. The role of speculative planning is crucial because it can raise aspirations and activate debates about the future of specific projects. ReMake Castlegate demonstrated that students and academics have the time and resources to develop hypothetical future strategies, or visions, which are not often possible to achieve through nonacademic partnerships.

Another important contribution that the university provides to UCP projects is represented by intricate and up-to-date conceptual and theoretical frameworks. The academic presence ensures a higher level of analytical introspection. In the UCP project Civitas ELAN, academic presence ensured a higher level of analytical introspection into the mobility process of the city, meaning that the processes were not only analyzed according to basic categories of demographics, statistical data, SWOT analysis, and so on, but included production of high quality

new solutions that were tested via review by other scholars (academics). The university is also essential because it constructs up-to-date methodological bases for terrain analysis. Analysis of the case studies Blackburn Live Project and Sostenuto revealed that engagement with the university raises the quality and standards for publication production, organization of exhibitions, workshop engagement activities, and so on. The project Fabric-ating further demonstrated that expertise brought in by the university in conducting and analyzing surveys also contributes to the establishment of a strong academic research base needed to structure the findings and decide on the crucial next steps within the project.

Naturally, it is usual for the university to add a more general, supportive, administrative, and logistic contribution to UCP projects. The mutual cooperation between the community and university is also shown through numerous community members' presentations, lectures, and workshops performed in universities' halls.

The University's Independent Character Facilitates Project Performance

Through the analysis of the case studies, it was possible to determine that the university's independent research represents one of the major assets for efficient UCP project performance. The analysis demonstrates that the university's research is (at least in the past "internal" case studies) independent and therefore more objective, because it is not constrained by private economic interests and expectations. The university's openness, which also derives from the absence of specific expectations, is essential for project performance. The independence of the university allows the students to generate fresh and innovative ideas not influenced or conditioned by the commercial realm, as occurred in Blackburn Live Project. The autonomous character of the university allows specific acute and unrestricted observations and considerations. In the project Civitas ELAN, it was possible to ascertain that the university, due to its independence from the municipality and other actors, was able to critically reflect and consequently upgrade the project's implementation processes. In a way, the recognized public role of universities represents a counterbalance to the specific self-interested aspirations on the part of certain political and private actors.

From the analyzed questionnaires it was possible to observe that the independence of the university has often been correlated with the term neutrality. The neutrality of the university within a UCP is crucial, especially with regard to the process of establishing a dialogue with the local community. This neutrality generates a trusting relationship that enables the university to take on the role of a referential partner within UCP projects, as in Civitas ELAN and Sostenuto. Through the analysis of the projects, it was noted that the involvement of the university as a partner in a project could, at times, provide much-needed trust, especially for the establishment of the initial dialogue with the local urban community; Fabric-ating provided an example of this.

The autonomous character of the university often enables it to act as an intermediary between various, often noncompatible subjects. The university can contribute to the mediation of private investors and city institutions. The university interprets its public role by promoting spaces of interaction between the local context (local communities) and other institutions (private companies, municipalities, NGOs) in which the university may act as an intermediary and enhance positive dialogue. Examples of this function included Mapping San Siro, Eco Silver House, and Fabric-ating.

Community's Effect on the University— UCP Improves the University

Although it is not directly relevant to the main research goal of this article, it is important and interesting to understand how UCP affects the university. Apart from knowledge and capacities that the university transfers to the local urban community, it is also necessary to determine the essential impact that the community has on the university.

From the case study analysis it was possible to ascertain that local urban community projects could bring several advantages to the university. Universities could learn from the implemented projects and acquire new methods to apply in future UCP projects. With UCPs, students integrate new practices of learning and working that are not possible in traditional learning processes; this occurred in Civitas ELAN. Blackburn Live Project demonstrated that in contrast to more conventional teaching methods, working directly with the community enforces collaborative and participatory skills that will be essential for students' future practices. In the UCP project Greenhouse, collaborating with the community enabled the students to integrate mutual learning processes and participatory practices in a much more practical and concrete way. Students were active on location full time, and they acquired collaborative experiences with the community members when they coorganized special events such as public meetings, "live mapping," explorative walks, and open gardens.

Within the UCP project Sostenuto, students, during their on-terrain "activation," were spontaneously encouraged to communicate and engage with other parties, which led to the formation of new perspectives in their learning process. Interestingly, in the case Fabric-ating, students recognized the hands-on character of the project as a missing link in their education process.

Transmitting new in-depth knowledge to students from which they can build their own research capacities and practices represents a clear benefit for the university environment. In the UCP project ReMake Castlegate it was possible to identify the concrete benefits of working in the same place for several years, which led to "situated pedagogy" and "live pedagogy" that became even more embedded. Close working relationships between the university and the local urban community provided new contacts with local community groups and with public and private institutions. In University of Neighbourhoods the establishment of a new stakeholder network—consisting of new local contacts—represented a valuable resource for subsequent common projects for universities.

For students and teachers, the different pedagogic process within a UCP entails a change in perceptions, attitude, and sensitivity. Through the development of these new abilities, it is possible to foster interaction that applies active and critical intelligence to face the complexity of urban events and to promote new civic growth. In Mapping San Siro it was noted that working directly through practice is a fundamental tool, especially for students and teachers of urban studies; it enables the development of reflective knowledge—a necessary component of good technical competence. In addition, Blackburn Live Project and ReMake Castlegate demonstrated that cooperating

with the community helps students develop specific soft skills such as interacting with clients and stakeholders, working together as a group, effective communication, encouraging participation, managing expectations, problem solving, conflict resolution, and strategic thinking.

Final Analysis and Conclusion

Based on a multiple case study analysis of relevant university–community partnership (UCP) projects in Europe, we have attempted to explicitly and concretely answer the question "Why is it recommended to involve the universities in local community-based projects?" A focused case study analysis of urban community–university partnership has enabled development of concrete arguments that can serve as recommendations to apply in future urban community–university partnerships or to stimulate the establishment of new partnerships. The analysis is summarized in eight potential benefits that universities could bring to university–community partnership projects. The following list of "university added values" emphasizes eight good reasons to involve the university within local urban projects. The list is not only intended to convince local communities to embrace the universities in their local projects, but also to foster in universities a better understanding of their potential.

1. Through the intensification of university involvement, it is possible to explore and research speculative, innovative methods and strategies.

University partnerships are typically experimental due to research activities and an innovative, exploratory nature (Trencher et al., 2014); that is, the university stimulates openness and freedom in research. The experimentation it supports within different research areas can open new alternative research dimensions that enable the detection of otherwise overlooked resources and voices. Such exploration of often obscure elements opens new possibilities, visions, and concrete solutions. UCP projects could benefit from university involvement as universities facilitate the research process with the development of speculative future strategies that are not achievable through nonacademic partnerships.

2. The university produces highly elaborated and up-to-date conceptual and theoretical frameworks.

An important function of the university is to generate conceptual frameworks with the construction of innovative methodological schemes and implementation strategies. The intensification of university involvement enables achievement of higher research standards. Potential areas of improvement include publication production, organization of exhibitions, engagement in workshops, and other activities.

3. The university is usually less constrained by private interests (including economic interests) and expectations and is not influenced or conditioned by the commercial realm.

The university's autonomy represents a counterbalance to the commercial realm, to economic interests and expectations. UCP partners can rely on the university's autonomy in terms of communicative and performative standards, as it enables and encourages a cooperative critical evaluation (together with the community) on the nature of the implemented solutions. The university's independent production and resulting objective research improve the final quality of the desired UCP outcome.

4. The university may act as an intermediary and enhance a positive dialogue between different stakeholders.

If a problem in the "dialogue" or a dispute between the different stakeholders within a UCP project arises, utilizing the university as a mediator is recommended. Within the public sphere, the character of the university often evokes the signifiers *neutrality* and *trustworthiness*. The university therefore could serve as an intermediary between various often noncompatible subjects. The university could also be integrated in a complex process of establishing an initial dialogue with the local community. In addition, its positive brand and neutral image allow the university to function as a merger of knowledge platforms, combining the skills and expertise of very diverse project stakeholders.

5. The university is a valuable and reliable partner in relation to administrative, logistic, and personnel support.

Apart from the obvious research contribution, the university also has a more general supportive, administrative, organizational

role, which could be advantageous for all UCP stakeholders. The university often contributes to UCP projects in various ways, offering administrative, logistic, and/or personnel support.

6. The university could and should express its maximum capabilities within deprived neighborhoods characterized by strong sociospatial inequality and intercultural conflicts.

The university should be more present in "real neighborhoods" outside traditional lecture halls (university campuses). Projects are best implemented in a neutral territory outside the traditional university campus—in "authentic" urban contexts, especially in deprived urban or suburban settings outside the comfort zone of the creative class. Working directly with local community members allows the university to access informal networks in order to better understand local needs and challenges. Universities should prioritize their efforts to support local communities in underprivileged neighborhoods with high social inequality. UCPs could strengthen the relationship, collaboration, and trust between the local community, the university, and other actors in order to initiate the process of improvement of specific socio-spatial contexts.

7. The university could establish new stakeholder networks—new local contacts.

The university represents a respectable networking agent that, due to its neutrality, has the potential to open new connections with local stakeholders. The university's networking character could represent a valuable resource for UCP projects and subsequent common (i.e., local) projects.

8. University engagement in new urban contexts could stimulate various forms of creativity within the local community.

UCP projects should actively engage the university because it encourages the inventiveness of all actors involved, thus serving as a powerful generator of innovative ideas. The university promotes a radical rethinking of how society might challenge the built environment. The university can inspire local citizens with fresh new ideas and embodies a connector of different knowledge platforms (as a promotor of "fresh" ideas).

The university could and should encourage ingenuity and introduce all stakeholders to unconventional perspectives. The university represents the fresh eyes that enable one to see new possibilities and inspire local citizens with fresh new ideas.

Although the main article's research aim focuses on potential benefits that the university brings within UCP, it is necessary to emphasize that the community has an equivalent significance and influence within the partnership. Collaborating with the community within a UCP brings several benefits to the university. The UCP represents a real-world setting, where university students can acquire and integrate numerous competencies: collaborative and participatory skills, reflective knowledge, conflict resolution, strategic thinking, co-learning, collective problem-solving, and more. Communities have a considerable impact on the civic knowledge attained by students, who recognize that applicable, tangible work within community projects should be more integrated in their educational processes. In addition, community projects based on civic experience influence students' personal growth, attitude, sensitivity, personal insight, and cognitive development.

If universities and local communities are driven by a common goal, together they could have a significant impact on improving the quality of life for citizens (Ishisaka et al., 2004). A university–community partnership could represent a realistic channel for developing different resources in order to address local community issues. However, expectations of partnerships are often too ambitious and available resources so limited that it is essential to expend effort establishing a realistic analysis, organizing, planning, and funding (Baum, 2000). The first step before establishing realistic goals and expectations is to understand the essence of each stakeholder involved in a UCP, as well as the characteristics, limitations, added values, and advantages of each partner. The first precondition is to acknowledge what our hidden potential is, what we are capable of. This article as a whole represents an attempt to bring to light the unexploited but considerable potential of universities, which should extend their focus (metaphorically and physically) outside the purely academic sphere and magnify their capabilities within local university–community partnerships.

Acknowledgments

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Collective Knowledge Mobilization Through a Community–University Partnership

Dadit Hidayat and Randy Stoecker

Abstract

This article tests the project-based research model by analyzing the processes and outcomes of a partnership between a grassroots environmental organization promoting community-based sustainability practices and a series of university-based capstone courses. We begin by contrasting scientist-driven and community-based approaches to sustainability. We then describe a series of three knowledge mobilization projects codesigned by The Natural Step Monona (TNSM) and university-based capstone courses led by a graduate student and professor. The first project performed a community diagnosis, from which we codesigned a prescription that the second capstone course helped TNSM implement. The third course worked with TNSM to evaluate the process. That evaluation, along with follow-up interviews, showed that the process had substantial and concrete positive community impacts that furthered TNSM's mission, but it also led to partner fatigue as the organization was pushed past its realistic capacity.

Keywords: community-university partnership, knowledge mobilization, collective action, capstone, project-based model

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Community–university partnerships have become increasingly popular as campus-based researchers try to make their studies more impactful. Researchers use various models that are expected to facilitate successful partnerships. Some researchers work with community partners to "translate" the findings of academic research into a form that can be better understood by broad lay audiences (Mercer et al., 2007), but because they do not ask the community what studies would benefit them, they do not empower communities. Other researchers go directly to the community and administer a more participatory process (Ballard & Belsky, 2010), asking the community what research they want. However, they often do not design their research to be directly usable by communities. Some of these researchers also engage students in the research. Doing so, however, can shift the focus away from community problem-solving in favor of student learning (Stoecker & Tryon, 2009). A project-based research model avoids these problems by pursuing knowledge production and social change simultaneously. The model begins with communities defining issues they want to address, and then connecting research (with or without credentialed researchers) with action through a cycle of diagnosing community issues, prescribing solutions to the issues, implementing the solutions, and evaluating the outcomes of the implemented solutions (Stoecker, 2005, 2013). The community, through its own leadership structure, remains in charge of the process throughout.

Applying the project-based model, which was developed mostly from social science research, to environmental issues poses further challenges. Environmental research has been driven predominantly by positivist natural science models and highly technical natural science methods that inhibit community participation. We seem to be lacking

in models showing how community–university partnerships could effectively contribute to more effective solutions to environmental degradation. The challenge is to strategically identify an approach to help implement such solutions in a specific community while also building the community's knowledge power (Foucault, 1975, 1980).

In this article we seek to develop such a model through studying a partnership between a grassroots environmental organization and a university graduate student and professor. The partnership used the complete project-based model, moving from diagnosing local environmental issues to designing a "prescription" for one issue, implementing the resulting solution, and then evaluating its impact. The results show the usefulness and challenges of the project-based research model for facilitating successful community environmental change.

Modes of Community–University Partnership

Because environmental issues so often involve natural science questions, it is helpful to look at practices framed as partnerships within natural science fields, as well as those derived from the more general engaged scholarship literature.

Scientist-Driven Approaches

The dominant models of community–university partnership are actually not partnership models at all. Scientist-driven *knowledge transfer* or *technology transfer* approaches may produce valid scientific knowledge, but they are unlikely to enhance community power. They are essentially a one-way flow of knowledge from scientists to segments of the public such as policy makers, clinicians, or clients (Johnson, 2005; Teece, 1977). Similarly, *translational research* "translates" scientific research to the "public" (Mercer et al., 2007), but that public is usually medical practitioners (Butler, 2008; Woolf, 2008). In these models, the common motivation is to communicate complex scientific knowledge generated through research, or to market products created through the scientific process, to the public.

The common issue facing these models is the unequal power relationship between the scientists and the public. Scientists are the active subjects providing the scientific information, while the public is passively receiving the information. Even when the scientific knowledge is valid, it also must be actionable. When a mutual understanding about the connection between the scientific information and the problem that needs solving is absent (Freire, 1973), the information is not actionable and the public, treated as passive by scientists, has little motivation to act on it.

In a second type of scientist-driven approach (though it is often described as collaborative), scientists invite the public to be involved in one or more stages of knowledge production designed to solve either practical or hypothetical problems. The original *action research* model, created by Kurt Lewin in 1934, included active participation of those experiencing the identified problems, but the scientist remained in charge of the research process (Marrow, 1969). More recently, Whyte's (1989) *participatory action research* practice involved some key informants from the partnering organization as collaborators in a later stage of the scientific inquiry. The *citizen science* model—also known as crowd science, crowd-sourced science, civic science, and a few other labels—encourages individuals without formal training to contribute data to a variety of research projects designed by credentialed scientists (Hand, 2010; Lamb, 2008). In all of these approaches the research question and methods, and the form of community participation, are determined by scientists with very little input from the community participants. When scientists treat community members as free labor for scientist-controlled research, community members are constrained to relatively passive participant roles, and the chances of their taking action on the science are reduced.

None of these approaches genuinely engage the community in participation that allows their views to strategically guide the process. Instead, members of partnering communities are treated as token participants or free labor. The ultimate learners in these science learning processes are scientists, who not only direct the knowledge production with little input from the community, but also maintain the ongoing dichotomy between credentialed experts and "experiential experts" with lived experience. The absence of community in strategic decision-making suggests an ongoing inequality in power-sharing in these knowledge produc-

tion approaches.

In a truly collaborative process, the technical expertise of credentialed scientists would matter only when connected with, and guided by, the experiential expertise of community members and leaders about community needs and perspectives (de Roux, 1991; Nyden & Wiewal, 1992; also see Nyden et al., 1997). Equalizing power in the knowledge production process increases the potential to distribute the benefits more equitably (Maguire, 1987) and increases the opportunities to produce societal levels of change through collective action (Stoecker, 1999). Equal power–sharing helps social relationships to empower community in addressing social injustice (Stoecker & Bonacich, 1992). Eventually, knowledge production that is driven by an empowered community would influence policy development and implementation, and help create a democratic society (Fischer, 2000).

This is not to say that forming an equal subject–subject partnership is without problems. Because communities are used to becoming victims of the dominating structure led by credentialed experts (Rahman, 1991), they are not used to a collaborative process where credentialed experts try to honor community-identified agendas. Implementing a participatory process with marginalized communities can be dilemmatic, unless the credentialed experts are genuinely willing to engage in a process that empowers communities.

Community–Driven Approaches

In contrast to the scientist-driven approaches that maintain power inequalities are community-driven approaches focused on developing a foundation for social change. Paulo Freire (1968) critiqued the traditional education system as serving the needs of the privileged while constraining the uneducated to live in a system created by and for those educated elites. Freire developed popular education to engage those excluded from power—for example, small farmers, racial minorities, poor families, and manufacturing workers—in knowledge production. The method is focused more on critical consciousness–raising that aims to empower marginalized people to liberate themselves and their communities (Freire, 1968). This approach also developed in the United States through the work of Myles Horton at the Highlander Folk School, now called the Highlander Research and Education Center, particularly in the civil rights movement (Adams, 1975; Horton et al., 1997). Horton thought that Blacks and Whites could meet together and improve their lives by participating in free discussions of problems, without indoctrination from preconceived ideas (Horton & Freire, 1990). This model has many empowering aspects, but it has not often been used in relation to environmental issues.

A related practice is the study circle model, started in Russia and then further developed in Sweden, which was designed to support popular movements organized by the working class and small farmers (Oliver, 1987). As marginalization occurs in both knowledge production and material production, the application of study circles has expanded from addressing social issues to science- and engineering–related issues and a variety of other problems where information is limited, in order to encourage the public to act (Oliver, 1987; Sarkadi & Rosenqvist, 1999). A facilitator, not a teacher, usually leads a study circle. Their role is to make sure that every learner in the study circle is also a teacher, and to build a supportive learning environment where everyone is comfortable learning from and teaching to their fellow participants (Barski-Carrow, 2000; Moss, 2008). In many cases, however, the study circle approach has become too formal and is not well linked to collective action (Brennan & Brophy, 2010; Oliver, 1987).

The *project–based* research approach is a relatively new model, building on the other community–based approaches and designed to connect knowledge production and social change, including research projects that use natural science information (Stoecker, 2005, 2013). Project–based research draws on the most empowering community-driven research approaches, which go by many names (Chandler & Torbert, 2003). The model follows four logical, looping steps. As a community (usually organized through some group or organization led by community members) defines an issue they want to address, they begin by *diagnosing* that issue—doing research to understand the issue and how it is impacting the community. Next, they engage in research to develop a *prescription*—a strategy for addressing the issue. Third, the community *implements* the strategy, and fourth, it *evaluates* the implementation. Sometimes community groups engage credentialed researchers in these

steps, and sometimes they perform them on their own. Regardless, it is the issue, and the community's desire to act on the issue, that leads the process. What has been missing in the previous approaches, which this model is trying to incorporate, is the integration of a community development practice that includes collective empowerment (Hickey & Mohan, 2005; Nelson & Wright, 1995; Selener, 1997). The community development approach enhances Foucault's (1975, 1980) power–knowledge loop where grassroots community members actively lead the knowledge production process to build their capacity to address their immediate community issues (Ball, 2012; Gore, 1995; Green, 1998).

The project-based approach, when it includes credentialed researchers, involves more collaboration than scientist-driven approaches. More than a mere supporter who has only a marginal or "advisory" role, a collaborator is involved in all research stages and is part of important research decision-making processes (Stoecker, 1997, 2012). Consequently, as collaborators fully participate in the knowledge production process, the learning that results can empower them to carry out their own future knowledge production activities that truly follow their goals for change and for a stronger power–knowledge relationship (see Foucault, 1975, 1980). In addition, this approach often focuses on specific issues in specific situations, increasing the likelihood that the research findings will be applicable in solving specific issues.

Our research explores how the project-based research model works when addressing environmental issues. How do partnering organizations benefit from a community-driven approach? What outcomes did the constituents of the partnering organization experience? How did the model challenge the community partner's capacity and leadership? To address these questions we will explore how a grassroots sustainability organization combined research with community development through the four-step project-based model, evaluating both the strengths and weaknesses of the model in this context.

Methods

This study focuses on a community–university partnership between The Natural Step Monona (TNSM) and a series of capstone classes offered through the Nelson Institute for Environmental Studies at the University of Wisconsin–Madison (Nelson Institute) between 2010 and 2013. The lead author had a relationship with TNSM for 18 months prior to the formal partnership as a participant in their study circle process and as a volunteer in a variety of community events. The second author became involved at the beginning of the project-based model.

In conducting the research on this community–academy partnership, we used a case study methodology (Yin, 2014). Case studies are particularly useful for investigating "holistically the dynamics of a certain historical period of a particular social unit" (Stoecker, 1991, 97–98). Our unit of analysis that constitutes a case is the partnership, not the individuals in it. Case studies are both historically and structurally bounded (Stoecker, 1991). For this case study the historical boundaries are the beginning of the first capstone course through the end of the third course. The structural boundaries are the social units most directly involved in aspects of the partnership—the graduate student and professor involved with the capstone courses, TNSM, Monona residents, the City of Monona, and other community-based organizations that participated in the implementation phase of the project-based model. Both the research conducted in support of the phases of the project-based model, and the research on the partnership, had IRB approval.

Data collected for the case study included interviews and documents. The first author conducted in-depth interviews with two members of the TNSM planning team, the second author, one member of the TNSM Board of Directors, and one Monona resident. We also analyzed documents (including a large number of exchanged emails) created throughout the project. Data analysis was conducted in a manner consistent with a case study. First, through interviews and documents we constructed an accurate history of the partnership, using a process called respondent validation (Torrance, 2012) or member checking (Birt el al., 2016) whereby we asked interview participants from TNSM to review and comment on the history. In analyzing the data we looked for major themes from the interviews and documents (H. Rubin & I. Rubin, 2012). We counted as major those themes that appeared in multiple interviews or documents and were affirmed through the member

checking and respondent validation process.

The Project–Based Research Model Process

TNSM was an all–volunteer community organization, established in 2005, that used The Natural Step framework, elaborating a whole–systems approach for the sustainability of human activities on Earth (James & Lahti, 2004). They focused on the approximately 8,000 residents of the city of Monona, a small suburb of Madison, Wisconsin. The Nelson Institute offers an interdisciplinary education and research program focused on complex environmental issues. In 2010–2015, the Nelson Institute provided funding for capstone courses that offered advanced undergraduates practical learning experiences with community–based organizations. We received funding for three consecutive capstone courses, taught on an annual basis, that comprise this project.

Five members of TNSM—the executive director, two members of the Board of Directors, and two Monona residents—joined in a TNSM planning team. The Nelson Institute team included the first author (a graduate student) and the second author (a professor who taught the capstone classes). A University of Wisconsin academic staff member also provided support for the first capstone.

In the textbook project–based research model, the first step is diagnosis. TNSM, however, was in the real world rather than a textbook. When the first author, who was already involved with the group, approached them with the partnership offer, their interest was in evaluating what they had been doing and then figuring out what to do next. So the first capstone course *evaluated* the impacts of TNSM's community programs from the previous 5 years and *diagnosed* what environmental issues were on Mononans' minds. To accomplish this, the partnership designed and implemented a citywide survey. Twelve students partnered with 12 TNSM members to knock on doors and drop off paper surveys (which could be mailed or completed on the web) at all 3,000–plus households in the City of Monona. In order to participate in the survey distribution and recruitment, TNSM members—some of whom had not taken a multiple choice test in 60 years—all had to pass the university's arduous human subjects research training. The capstone students analyzed the 631 surveys, then created and presented posters at a TNSM public event, during which we also facilitated roundtable discussions where we asked Mononans to prioritize issues and *prescribe* strategies based on the survey results.

The survey results and community event highlighted the importance of water issues in the community—both the health of Lake Monona and the quality of drinking water. So the second capstone course supported the Year of Water—a collaboration between TNSM and the City of Monona (the new mayor was a TNSM member). The prescription resulting from the community meeting and subsequent meetings between TNSM and the authors included two strategies. TNSM carried out its own "water challenge"—a contest with prizes for residents who could conserve the most water and come up with the most innovative water conservation strategies. The second strategy involved other Monona community–based organizations in designing and implementing water conservation projects. These prescriptions were not derived from a traditional research process. The community event served as a kind of crowd–sourcing process to collect possible prescription strategies, which set the boundaries for the possible prescriptions. TNSM had been thinking about enacting the first strategy for some time. The professor then brought existing research supporting the second strategy to TNSM.

We then moved into the *implementation* phase. For the second strategy, the TNSM planning team and 12 students enrolled in the second capstone course identified community–based organizations (CBOs) in Monona. They designed a PowerPoint presentation about the Year of Water and various water conservation activities for individuals and groups. The students presented the PowerPoint to the CBOs and recruited 13 of them for water conservation projects ranging from education programs to rain gardens. As predicted by the project–based model, some of these implementations also involved research, as groups had to educate themselves about things like how to create a rain garden, or start their own water conservation education program.

The third capstone evaluated the impacts of the CBOs' water conservation projects on their members. After obtaining IRB approval, nine students conducted in–depth interviews with leaders of the CBOs that

Evaluate (capstone #3)
- community impacts

The 2012 Year of Water

Evaluate and Diagnose (capstone #1)
Public familiarity to the partnering organization -
Public involvement -
Current sustainable practices -
Immediate community issues -

Implement (capstone #2)
Identification of local CBOs -
Water-focused engagement -

Prescribe (capstone #1)
- Strategies informed by survey results

Figure 1. Summary of the Community–University Partnership Between The Natural Step Monona and the Nelson Institute as Presented in the Project–Based Research Cycle

had organized water conservation projects so that TNSM could learn what worked and didn't work in implementing the second strategy. The overall partnership process is summarized in Figure 1.

Findings

How Partnering Organizations Benefit From a Community–Driven Approach

The community–university partnership is increasingly regarded as a strategy to help academic scholarship be more relatable to the community (Curwood et al., 2011; V. Rubin, 2000). For a small all–volunteer organization such as TNSM, partnering with a research university can serve to enhance legitimacy. All three TNSM members interviewed indicated that the partnership gave significance both to TNSM as a grassroots organization and to the environmental cause TNSM was committed to addressing. TNSM members believed the enhanced legitimacy allowed them to expand their outreach to more Mononans, as the following quotes illustrate.

> "So great benefits . . . we got out there in the public in a way we never could have, to give us a name recognition and the cachet of working with the university. It made us more substantial."

> "It was huge for the organization, The Natural Step organization, and huge for the community to be able to establish a partnership with you and your studies and the Nelson Institute. It helped within our realm

of people who were supportive of environmental studies to know that there was almost a legitimacy."

> "It gives it more appearance of something that is important that should be paid attention to, that more people could follow. And maybe would break down some barriers for some folks that are like, 'Is it something that it's worthwhile for me to put my time into.' So I think with more legitimacy behind it you get more support."

One of the typical challenges for an organization as small as TNSM is being strategic about fitting local actions to available resources. Without a carefully crafted planning process, an organization can risk having either too many disjointed ideas supported by inadequate resources or too few ideas with resources not being optimized (Staples, 2012). The first partnership project supported this need to focus by conducting a study that combined evaluation and diagnosis (Hidayat & Stoecker, 2018; Hidayat et al., 2014). This combination requires an intensive planning process that a small community organization like TNSM may not have the resources to support. The academic partners provided the needed skills and expertise so that TNSM could carefully develop priorities and the strategies to realize them. TNSM planning team members agreed that the academic partners helped TNSM choose practical ideas.

> "I am thinking about those meetings [between academic partners] and our team, and I think we would

go far if we start talking idealisti- cally and what ifs, and I think, [the professor] wouldn't let us do that. He would be bringing us back to what we really mean."

"I was totally amazed, I think, throughout that process, both in how you dealt with us and how you kept throwing the questions back to us: 'What is it that you want, please clarify, help us understand, what it is that would be most valu- able?' And at the same time, there was some guidance in terms of maybe what we could accomplish; what resources the university could provide. But so much about it was I thought focused on really helping us figure out what the idea was, what really did we want to ac- complish, and how could we step forward initially."

The academic partners intentionally put TNSM in a critical decision-making role for the project. When asked about how much voice they had in the partnership, and how they felt about their roles in directing it, TNSM members were confident that TNSM had a strong voice.

"The community was in control. We established that survey [in the first capstone course] and gathered input from the community. So that was what this is all about, and that was what The Natural Step was about as well, that is, having this as community-based. So making sure that it was representative to what was important to the community."

"I never felt that we were backseat. I felt we were directly . . . you know . . . that it was real important for us to be there. And that we were almost leading the acting [laugh hesitantly]. I mean, really! And we weren't . . . but we were!"

Another member of the planning team suggested that being a female in the group (all of the members of the TNSM planning team were female, and the academic part- ners were male) could be a factor. In such a gendered relationship that overlaps with a status-difference relationship, there is often a problematic power imbalance. In this case, the male academic partners' supportiveness

toward the female community members helped form a trusting relationship.

"I clearly felt supported, I guess I have to say that. And maybe that's just the female experience [laugh], it's not usually a supported one, we're usually the supportive [one]. And so . . . to have . . . your opinion or your thoughts really valued in that way was kind of unique. Not that it never happened before, but it certainly was so continuous in the process."

Community engagement was central to the project goals identified by TNSM, but group members lacked a clear concept of how they should achieve such engagement. The plan- ning group appreciated learning how the academic partners practiced community engagement.

"The methodology behind how to help getting community engaged. What types of tools and practices to use and theories behind when you are looking at people—What do they find important? How do you help find out what is impor- tant to them? And how . . . you have to understand how each individual is going to need to balance their priorities. It's the social science part of it. That's what I learned a lot. And having a particular focus, a topic focus, where everybody in the room is focused on one thing but still seeing how each individual has their own perspectives and their own experiences and talents and skills to bring to the conversation to see how that is . . . representative of a diverse community and being able to . . . effectively spread the message out."

"Because, again, not having the right type of people in the structure to go out and legitimize ourselves and as an organization to start building it up, it's more like 'Hey, I am in the community, I think this is important, come and join me, we'll talk about this thing.' . . . This [partnership] provides us more structure [in how to engage Mononans]."

The involvement of students in the part-

nership offered additional brain power and energy to execute civic engagement strategies that both partners would agree on.

> "It was totally amazing to me that [the professor] could take a group of students that had committed to something they really didn't have any idea what they were committed to. So they must have been special . . . students anyway. But it was just so exciting to see them engaged in a way and I don't remember what it was like to be a college student, but they were so sophisticated and so willing to reach out and to be left in this amorphous thing and drawn into it and be part of it. I think I felt that connection was just amazing. And they have this knowledge base along with [the professor] that they brought to us. The manpower, the intellect, and the engagement, that was so neat to have."

> "I think that with the small local community like we were in Monona here it was difficult to engage people. With your support we were able to bring more people and with students to have more work to be done."

Outcomes for TNSM and the Community

Building on the momentum of the first capstone course, and its identification of water sustainability as an important theme, the partnership focused the second course on engaging Mononans on water sustainability (Hidayat et al., 2014). The preparation and execution of the second course allowed the partnership to discuss community engagement theories and practices. With the involvement of the capstone students, the partnership designed strategies to support water conservation projects during the city-designated Year of Water.

The planning process for the second course was dynamic, and it took some time for the planning team to come to agreement. The partnership eventually committed to adopting a bloc recruitment strategy that is popular in social movements. Bloc recruitment is "the way in which social movement organizers often recruit members and participants among groups of individuals already organized for some other purpose"

(Oberschall, 1993; see also Oberschall, 1973). It is relatively low cost, because it relies on existing trusting relationships, mutual interests, and consolidated routines within a network of CBOs (Diani, 2013). Our implementation involved identifying local CBOs, engaging them in the Year of Water, and encouraging them to carry out a water conservation project. Engaging these groups would allow TNSM to dramatically expand its impact without having to do it all themselves.

Planning team members had differing opinions on the bloc recruitment strategy. One member was immediately supportive because she recognized TNSM's limitations.

> "I think that it's [bloc recruitment] very natural. I think that it should be promoted more. I am a process efficiency perspective person and process improvement and so [I asked], 'How come all of these disparate efforts are going on to accomplish the same thing? Why don't those organizations—either nonprofit, or business, or for-profit—find a way to partnership together in a similar cause and bring all those efforts together?' Because, The Natural Step Monona, we're a small organization. We don't have a lot of power behind us. We maybe just try to reach our community, but we could be reaching others. But we're putting time and efforts and asking for participation, and asking for money, from the same pool that other people are as well. So, it's great if you want to just have a little branch in your community and that's all that you do. But if you're trying to build up and to really want to be a voice, and get support, the partnerships are vital and they're crucial, because you have to band together resources."

Despite being unclear about the strategy, the idea of connecting members through existing groups made sense to another member.

> "The group idea hadn't really been mine and I don't think I understood all the ramifications even afterward. But I understood that it made sense to sometimes go through community groups, churches, fishing

groups, or business association[s]. I think ultimately it has happened to some extent here. And that was probably a good thing."

While eventually agreeing to the strategy, a third member was pessimistic that CBOs would actually be willing to participate. She feared the project might become a burden because it would require additional planning and implementation beyond their existing programs.

"We were asking more of people. [The professor] had the idea of working with groups because then you get a lot more people involved, but we were asking them to do a lot. The first thing we do [is the] survey, 'Fill out the survey, take 20 minutes, you're done, bye, we don't see you again.' We will see how much it would have been an impact to your life. But when we were going to a group and said, 'Hey, we want you to take on a project!' . . . 'What? Huh? You want me to add more on my plate?' I think the request might have been too big and that there were not enough groups out there to make it worthwhile."

The strategy facilitated TNSM in helping local groups build on their unique interests and turn them into practical actions. In addition, the various types of groups— formal learning, faith-based, and advocacy groups—participating in the actions demonstrated the flexibility of this strategy in engaging the broad interests of local communities.

How the Partnership Challenged the Capacity and Leadership of TNSM

Although community–university partnerships have become common in the past three decades (Hutchins et al., 2013), it is still uncommon for universities and colleges to mobilize their resources under the direction of a local community group (Mondloch, 2009; Ward, 1999). The participatory practice integrated into the project-based model allows the local community to play a key role throughout the project (Stoecker, 2009). Analysts also believe that the long-term partnership—ours lasted for 3 academic years—multiplies those benefits (Tryon et al., 2008). However, the benefits may come with consequences to the com-

munity partners, especially for small community organizations (Busza, 2004).

The interviews reveal challenges that TNSM experienced as they participated in the partnership. Being collaborators and leaders of the partnership cost members of the planning team a significant amount of time and energy. All members of the planning team were enthusiastic and committed to the first capstone class. As the partnership progressed to the second and third classes, the level of commitment was not as strong. One planning team member indicated that the big difference between the three classes was mostly caused by the different level of enthusiasm from the planning team.

"I think the first one was exciting for people. By the time we were at the third one, there was not a lot of support from anybody, like it was not that exciting, and I feel I was the only one who cared about any of it. I think [one member of the planning team] maybe came to one or two of the classes on the third one."

Another member of the planning team discussed the experience of getting involved intensively in three capstone courses, adding that it could be a natural consequence in a voluntary organization working over a longer period of time.

"I think the organization, because the length of time that the leadership had had to engage more independently, kind of fried that group of people. I don't think the participation of the university made that worse in any way. I think it was sort of a natural [consequence] of those who make that first step forward."

The ability of the leaders of a voluntary organization to devote time and attention to the organization's changing context is crucial. The desire of those of us from the university to have TNSM lead the process created two challenges that many nonprofit organizations have not faced. First, despite, or perhaps because of, the strong intention of the university partners to honor the voice of the local community in the partnership, community members were expected to invest time and energy at a level they may not have been prepared for. The disconnect between the well-intentioned expectation

from the university actors and the actual capacity of the local community to meet that expectation can lead to burnout for community organization members. For a TNSM staff member, the impact of the partnership on their workload was more significant than for other members of the planning team who were volunteers.

> "I think the frustrating moments for me were mostly just how. . . . There was so much added to the plate, because we didn't stop doing Green Tuesdays and Thursdays and we didn't stop doing all other things we were doing which I couldn't remember. . . . and then we got the board trying to organize like we were a huge organization, trying to do our operations or whatever. Oh, it was too much, it was too much, I exploded, 'Busshh.'"

Next, in a small nonprofit setting, like TNSM, it is common to find a single staff member who works alone to get things done because explaining the task to others would take more time (Hayman, 2016; Mondloch, 2009). So instead of communicating with others as part of building the collectivity within the organization, this staff member goes ahead completing the task alone. This is a missed opportunity that could lead to capacity building for collective action. A board member who was not in the planning team indicated the lack of clarity about the partnership that can result:

> "I knew that the Nelson Institute was involved. I never did have a really clear idea all those years of what was your goal. From my point of view, it was we had access to people who could do some research in the community that we could then get some information from or we could have some impact with. Maybe even more than students giving us information, they would be our ambassador to some degree in the community to get more information about us too. That was my primary understanding. It was never clear to me, quite frankly, what the Nelson Institute was going to get out of it, and what we're going to get out of it."

Others also noticed the challenges facing the TNSM staff member who was also a member of the planning team. This staff member was very involved in the partnership and was "really enjoying" being part of it. The staff member was also a cofounder of the organization and was understandably committed to its mission. But it was difficult for her to communicate all that was involved in maintaining the partnership, as illustrated by a board member's comments:

> "She was spending an awful lot of time with the Nelson Institute. I do remember at the time thinking, 'What's going on, why didn't you spend more time on the Natural Step business rather than the Nelson Institute business.' She was really excited and pleased and she loved going to those classes and stuff. As I am sitting here I do remember in the board meeting [she said], 'Well, I got to do such and such, I have to be at the university,' you know . . . that sort of thing."

For a small organization like TNSM, the already challenging environment is made more difficult with the additional task of having to provide support for the university in running its capstone courses.

Discussion

Based on a 3-year community–university partnership involving three capstone courses, this case study investigates the benefits and costs of the partnership to the partnering organizations. The findings demonstrate consistency with the literature, and also extend it.

TNSM interviewees were confident that they had at least shared control of the partnership. Rarely do we find community control as a main descriptor of a community–university partnership. In the literature, reciprocity (Suarez–Balcazar et al., 2005), mutual learning (Gelmon et al., 1998), and active participation (Curwood et al., 2011) are more often cited to describe a collaborative relationship between communities and academics. The problem with using these terms is that people do not always recognize that communities and academics come from two different power positions (Stoecker, 2016). Following Freire, academics have had the privilege of accessing high quality education, whereas community members may not have. The assumption that community partners would input the same amount of

resources as academics in a partnership is not only unfair (because they do not have the same amount of resources) but also uninformed (because academics typically have more resources than communities do).

This assumption of resource equality is even more problematic in a typical scientist-driven environmental partnership context. The possession of scientific information by academics and the consumption of the information by communities will set up two distinct roles in most environment-focused partnerships. In our case, however, TNSM had developed its own natural science–based environmental expertise, and thus was not at a knowledge disadvantage in terms of environmental science in this project. In fact, neither of the authors were natural scientists, and TNSM's expertise actually helped balance power in the partnership. This has important implications for natural scientists wanting to partner with communities. It may be a prerequisite for community members to have their own expertise before engaging in partnership.

However, it is also true that TNSM members did not possess the same breadth of knowledge on community engagement as the academic partners, which could have created a power imbalance. Fortunately, it did not, possibly because TNSM members possessed other kinds of knowledge that the academic partners lacked. Our takeaway from this is that academic partners need to both ascertain and respect community expertise in any partnership. We believe the other reason we maintained a relative balance of power is that we followed the project-based model, which emphasizes the importance of community leadership, not academic leadership, in the partnership. That means community leadership even in the research aspects of the partnership.

TNSM's status as an all-volunteer grassroots organization makes their perception of control more important. The challenges for this type of community organization in supporting a partnership are immense (Stoecker, 2016; Stoecker & Tryon, 2009). For example, members of the TNSM planning team had to make time to attend planning meetings and organize community meetings and actions, at least some of which involved evenings and weekends. Scheduling often presents challenges in community–university partnerships (Tryon et al., 2008). So it is not surprising when academics typically partner with organiza-

tions that have better resources and dedicated staff members to participate in the partnership, such as government agencies, schools, businesses, or well-established nonprofits (Ward, 1999). Indeed, the practice of selecting well-resourced partners to meet academics' agendas at the expense of organizations that need the most help in addressing immediate local issues is common (Stoecker, 2016; Tryon et al., 2008).

Although TNSM managed to take strong leadership in the partnership, they could not escape the extra workload that the partnership had added to their plate. After the successful first capstone class, where TNSM went at full speed in participating, they had exhausted their limited resources such that they were unable to demonstrate the same commitment and energy in the second and third classes. This finding poses questions regarding the efficacy of the project-based research approach as well as the long-term partnership standard, and suggests that the broader practice of community–university partnerships has not been sensitive to the challenges that a community has to endure to be a full partner.

How could the approach be more sensitive to the community's "partnership fatigue" that likely affects the success of the partnership itself? In the case of our partnership, the offer of a capstone course led to a kind of add-on approach. TNSM added the partnership onto their existing activities without adding any capacity to participate in the partnership. That meant that the TNSM core group went to even more meetings and did even more work. Perhaps we could do better at designing partnerships around existing activities instead of designing projects that expand the work of the organization. It might be possible to engage in an initial partnership conversation to find out what the organization is currently doing, and what information gaps they are experiencing in accomplishing their current work. For example, TNSM was engaged in regular community education programming. We might have been able to set up the capstone course to search out and curate further education resources, or design education modules. That would have been a one-off effort, not a long-term project. It also would not have had the visible and significant impacts that we observed. And we can't say whether that would have impacted the longevity of the TNSM leadership. In the end, of course, if the community is going to lead, they have

the right to choose the more intense route. What is important is for them to understand that it may be a more intense route. Our research now can help academic partners have a conversation with community groups about the potential consequences of such a choice.

In the final analysis, one of the most important benefits of community–university partnerships is that, as scholars become more engaged in the community, the products of scholarship can be more relevant and impactful (Sadler et al., 2012). The hope is that, by building positive relationships with community partners, academics will be better informed by the community's socially and culturally grounded understanding of particular issues (Silka et al., 2008). Additionally, this study shows that TNSM was at least partly motivated to participate in the partnership because they recognized their need to better understand the theories and practices of community engagement. Indeed, effective community engagement is not only important for academics (Laing, 2016) but also for communities (Bell & Carlson, 2009). It is for this reason that the project-based research model offers a good case of a subject–subject relationship that facilitates productive learning, and at the same time balances the power differential between the two partners in learning (Freire, 1973).

We know that not all community partners and academic partners approach a partnership the same way as TNSM and the Nelson Institute did. In our case the project-based research approach facilitated the partnership so both partners were encouraged to learn from each other. This contrasts with the scientist-driven models of commu-nity–academy partnership focused on the environment that offer content knowledge more than process knowledge. The lack of success in building broad public support for environmental sustainability suggests that such content-focused models will not work. Instead, this study demonstrates that paying attention to the process of the partnership helps build additional capacity for environment-focused organizations such as TNSM and offers more effective solutions to environmental degradation.

How does this study inform the practice of community–university partnership? The partnership showcases how both partners embraced Arnstein's (1969) ladder of participation and brought their collaboration further toward the top of the ladder of community-based power. It shows that community-based power does maximize the benefits of community–university partnership to partnering organizations, especially small organizations with limited resources. However, partnering with such organizations requires that academics develop a deeper understanding of the organization's available resources so that the partnership maximizes benefits and minimizes burdens. The challenges facing short-term partnerships are well documented (Tryon et al., 2008); however, as this case illustrates, long-term partnerships present challenges too. Additionally, scholars may want to focus more on community engagement research so that they are better equipped with theories and best practices. Finally, an important element of community–university partnerships is capacity building so any partnering organization will be better off once the partnership is complete.

About the Authors

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Science with Seniors: A Model Program for Senior Citizen–Centered STEM Outreach

Suyog Padgaonkar and Emily A. Schafer

Abstract

Many science, technology, engineering, and math (STEM) outreach programs focus on children, but relatively few efforts are dedicated to voting-age populations. These groups are important to reach because misinformation about science is widespread and difficult to detect, often interfering with informed voting on science-related issues. Science with Seniors (SwS) addresses this critical gap by bringing science research topics and news to the most dedicated voting demographic, senior citizens. Through SwS, graduate students and postdoctoral associates have delivered informal presentations on current and relevant science topics. Participating seniors have indicated that SwS has increased their understanding of the presented topics and that they would attend similar programs in the future. The article outlines a general program development methodology to support implementing this graduate student–led model elsewhere. Future directions include program expansion, additional online access, and evaluation of long-term effects on participants' voting habits and appreciation of science.

Keywords: science outreach, STEM, program development, graduate students, senior citizens

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The relationship between Americans and their views on science is, in general, complicated. On one hand, the vast majority of Americans trust scientists and believe that investment in science pays off in the long term (B. Kennedy & Hefferon, 2019). On the whole, Americans' understanding of science has increased over time (National Science Board, 2018). At the same time, Americans have become increasingly susceptible to misinformation about science, a trend fueled by the growing significance of media and political polarization in recent years (B. Kennedy & Hefferon, 2019). The majority of Americans share views with scientists on most topics, but certain issues, such as climate change or genetically modified organisms, have seen large disparities develop between views held by scientists and those of the public (Druckman & McGrath, 2019; Funk & Kennedy, 2016). Alongside this troubling trend, surveys measuring public understanding of science reflect stark differences between age groups. More often than not, older adult Americans (aged 65+) tend to score lower on overall science knowledge than their younger counterparts (Funk & Goo, 2015). Independent of their performance on these science literacy tests, senior citizens tend to vote at much higher rates than other age groups. In 2016, over 90% of senior citizens were registered to vote, and over 70% turned out to vote, in contrast to just over 45% of Americans ages 18–29 (Bunis, 2018). Scientific information is important in informing policy, but misinformation can just as easily be used to create policies by influencing voters and public opinion. As a result, it is crucial that this highly dedicated voting group be properly informed about scientific issues, particularly those that have policy implications.

Scientists engage the public in two primary ways: direct outreach (through public talks, conversations, or interactive activities) and

citizen science (creating projects where the public can contribute with data collection or analysis). Although older adults have engaged successfully in a number of citizen science projects, this article's primary focus is effective program development for science outreach with senior citizens (Cronin & Messemer, 2013; King et al., 2016; Merenlender et al., 2016; Tuckett et al., 2018).

Currently, nearly all science, technology, engineering, and math (STEM) outreach efforts focus on increasing early interest in science among younger populations (children under 18; Andrews et al., 2005; M. Kennedy et al., 2017; S. Laursen et al., 2007). STEM graduate students are often eager to volunteer in such programs, motivated by intrinsic emotional benefits, a desire to enhance their teaching skills for career advancement, and the perceived ease and fun of teaching children (S. L. Laursen et al., 2012). These programs are often short-term and low-commitment endeavors for volunteers, involving brief lesson plans with interactive demonstrations, crafts, or other physical activities (S. Laursen et al., 2007). These outreach efforts aim to instill a love and appreciation of science early in childhood, reinforce broad skills for education, and inspire large percentages of students to pursue science-based careers (S. L. Laursen et al., 2012). Although this form of outreach is certainly important to build the next generation of scientists and emphasize informed science knowledge in all stages of life, it overlooks the general population of voting-age adults.

The most reliable voters in elections are senior citizens, yet to our knowledge, only two STEM outreach efforts have reported targeting this critical demographic. At the University of Missouri, the Science and Me program consisted of a novel 15-week course designed to train graduate students to build effective science communication skills. Over the course of 2 years, students who participated in this program gave 62 presentations and reached over 1,000 adults in independent living facilities, public libraries, and college reunions (Alexander et al., 2011). Feedback on these efforts was largely positive—audience members thoroughly enjoyed the chance to learn about current research topics, and students appreciated the chance to reach new audiences while improving their science communication skills. Another STEM outreach program that targeted senior citizens consisted of a series of monthly astronomy-related lectures to audience members in senior living communities in Rochester, New York (Rapson, 2014). This endeavor not only enriched the lives of seniors who grew up during a time when space science was a growing and popular field but also reminded participants of the importance of funding scientific research and related technologies. Importantly, this program built upon the work of existing lifelong learning institutes (LLIs) at its community partners, in which senior living communities or senior centers hold educational programs on various topics, such as yoga, cooking, travel, or literature. The overall goal of LLIs is to improve cognition (and prevent cognitive decline) by continuing to engage mental faculties of participants through intellectually challenging material (Simone & Scuilli, 2006). Additionally, LLIs promote intergenerational social interactions, prevent depression, and increase self-esteem and self-efficacy in decision-making processes (Brady et al., 2013; Lamb & Brady, 2005; Simone & Scuilli, 2006; Talmage et al., 2019). The work of such well-established LLIs as Osher LLI has demonstrated that the most effective facet of lifelong learning is promoting reflective judgment on existing beliefs so that these can be critically analyzed and independently revised if necessary (Lamb, 2011). An interactive learning format that encourages dialogue between the student and teacher promotes this type of reflective judgment.

Learning from the successes and challenges of these programs, an optimal science outreach program for older adults would both teach a wide range of scientific topics in depth to community members in a long-term sustainable manner and promote reflective judgment through interactive and engaging formats. Such a program should seek to build a framework that can ensure the most civically engaged demographic is scientifically informed by answering the following questions:

1. What are effective ways to engage senior citizens with science outreach?

2. How can senior citizens benefit from science outreach?

3. How does science outreach affect the attitudes toward science and voting habits of senior citizens?

Science with Seniors

In order to fill this gap in current outreach efforts and begin to answer these questions, we started an initiative through the Science Policy Outreach Taskforce (SPOT), a graduate student and postdoctoral associate–led organization at Northwestern University (NU) that is committed to advocating for science to policymakers and the general public. We (graduate student members of SPOT) have developed a model program called Science with Seniors (SwS), in which graduate students and postdoctoral associates from NU bring their expertise to local senior centers and offer brief, digestible science presentations on a variety of topics. Although we encourage NU presenters to relate their talk to current science news or policies to strengthen the connection between a basic understanding of science and governmental decisions, as a nonpartisan organization, we avoid expressing political opinions or telling participants how to vote in upcoming elections. Overall, SwS seeks to inform participants about science topics that impact our everyday lives, improve science literacy, and share an appreciation for scientific research and its outcomes, all of which can lead to more informed voting.

Program Development

To best reach this demographic, we chose face-to-face interactions in order to readily combat misinformation, which rampantly spreads online, with personal conversations (Jones & Crow, 2017; Scheufele & Krause, 2019). We developed SwS with a two-pronged approach to establish relationships with both community partners and presenters, as shown in Figure 1. To establish community partners, we contacted local senior homes to gauge interest in partnering with SwS. We then visited the partner sites to understand how our values align. After giving a trial presentation, we established a set of dates for presentations to take place and advertised these events at the partner site.
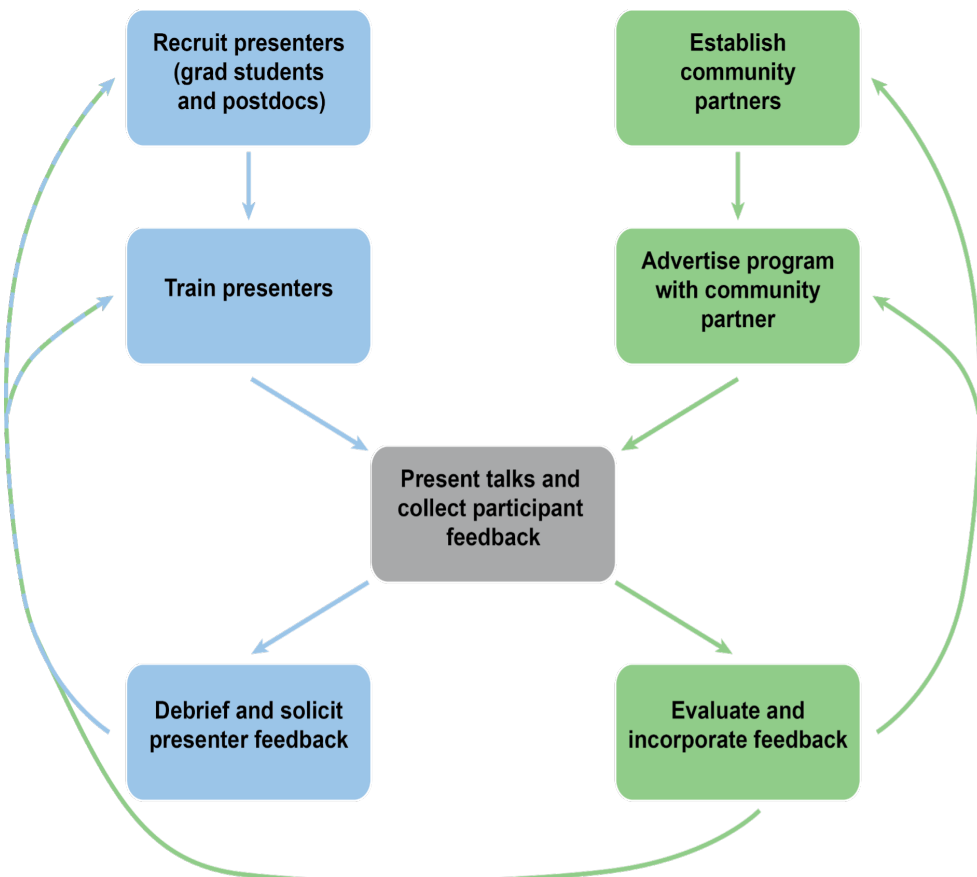
Figure 1. Program Development Steps for a Senior Citizen–Focused Science Outreach Program

Alongside these efforts, we recruited presenters (STEM graduate students and postdoctoral associates) at NU through information sessions. Many prospective presenters have experience with science outreach (primarily to children). They want to reach new audiences in the greater Chicago community and grow their science communication skills. We trained presenters by providing volunteer primers, which describe strategies for successful presentations as well as examples of past successful presentations. After presentations at the senior centers, we distributed surveys to solicit feedback from the participants to evaluate the program and continue advertising future presentations. Much of the feedback suggested future topics of interest, and we have recruited presenters with expertise in these topics. Other feedback about how the program could be improved, such as presentation style, has been incorporated in the training step. Expansion to new senior centers is possible after establishing a successful track record with the initial community partners. After the presentations, we also debriefed with the presenters and solicited feedback on how to improve the program from a presenter perspective. This feedback has been incorporated into the training and recruiting steps as well.

Community Partners

We established community partnerships with two local senior centers. In June 2017, we partnered with the Covenant Home in Andersonville, a northern neighborhood of Chicago. In December 2018, we partnered with the Levy Center in Evanston. The Levy Center population consists of independent community members since it is a daytime center; the Covenant Home is a live-in senior residential home. These populations differ in demographic makeup and cognitive capacity; however, we did not collect information on these aspects during the course of this program evaluation period because we used anonymized surveys to gather feedback. To build on this progress in the future as a science education research project, we would be interested in studying the differences in science literacy and overall understanding resulting from these presentations between the senior center populations and evaluating whether personal characteristics (age, education, gender, cognitive health) play a role in individual attendance and behavior.

Format

Our presenters consist of graduate students and postdoctoral associates who have demonstrated interest in our program by attending a recruiting information session. One or two volunteers sign up for a date to present, which occur monthly at each center, as seen in Figure 2. Our volunteers originate from a diverse range of STEM

Figure 2. A Graduate Student Presenting on Lab-on-chip Technologies to Seniors at the Levy Center, January 2019

Table 1. Advice for NU Volunteers	
Frame the talk around interesting, engaging questions.	Keep in mind that these participants do not regularly attend science talks and may need to be persuaded that your content interests or relates to them. For example, "Why should you care about solar cells?" is more effective than "What are solar cells?"
Keep the presentation relatively broad and non–technical.	Give an overview of the topic and introduce the relevancy of this topic into the participants' lives.
Don't assume prior knowledge.	It is encouraged to define what scientists may perceive as simple concepts, even things like what the periodic table is and how electricity works. Some of the participants may not have formally studied anything science–related since high school 50+ years ago. Never use field–specific jargon.
Give historical context for your field.	Additional historical context and landmark events can help the participants connect more to the topic and your research. It also helps them appreciate the growth of your topic over time, and how far the field may have progressed.
Consider why they should know or care about the topic.	Think about these questions: Can they use it in their lives? Does it help people? Will their kids, grandkids, or future generations be impacted by it? As scientists, we may not test the relevance of your research in our daily lab work–life, but this potential impact is likely why the research is funded and how a lay audience can understand it.
Tie your topic to current news stories.	Many residents follow the news closely and will both understand more complex topics easier and remember the content of a presentation better if they can connect it to current events.
Connect your talk to policy.	Find recent policies, proposed budgets, recently introduced bills, or forthcoming policy changes that are relevant to the presentation. Explain the impact of policy on the field and how the participants can affect a change without endorsing any particular decisions, candidates, or political parties.
Make the presentation interactive.	Are there any props that may help increase understanding? Is there an interactive demonstration that could bring clarity to the narrative? Alternatively, consider creating a presentation that is primarily an interactive demonstration with an underlying message.
Be prepared to answer questions.	Don't expect to have all the answers, especially when they are unrelated to the field, but we as scientists are an advocate for science in general. We need to learn how to step out of our comfort zones and be willing to talk about science outside of our area of expertise. This program should be used as a time to practice and develop these skills.
Be sure to enjoy yourself!	The participants love talking to visitors. Being friendly and honest about your scientific knowledge also will show them that scientists are human too.

departments throughout the university, including chemistry, biology, physics, astronomy, earth science, materials science and engineering, medicine, biomedical engineering, sociology, psychology, and other departments. The topic that each volunteer chooses can be related to their scientific research or simply of interest to them. Presentations to date have focused on a variety of scientific topics, including brain–machine interfaces, lab-grown meat, antibiotic resistance, animal skin patterns, QLED TVs, climate change, MRIs, and more, again reflecting the broad range of subject matter studied by the NU volunteers that presented. Since the program's inception in 2017, we have had 54 unique presenters, with 31% of those returning to present more than once.

Our volunteers prepare 15–20 minute talks (typically in, but not limited to, a traditional slideshow format) with ample time for questions. We train the volunteers to refine the talks to be accessible for senior citizens. To help presenters prepare, we provide a volunteer primer with population-specific considerations along with sample slides from well-received presentations. The primer consists of tips that we consider vital for effective science communication to nonscience audiences, described in Table 1.

Methods of Program Evaluation

To understand the impact and effectiveness of SwS in its aims, we designed anonymized surveys that we distributed to participants after every presentation, as shown in Table 2. First, the surveys were designed to assess the degree of accessibility and communication of the content shared by the presenters. We asked if the presentations were helpful or engaging and if they increased participants' understanding of science topics. We not only received direct feedback on volunteers' efforts to communicate and engage participants effectively but also learned if presentations increased overall interest in science and willingness to participate in similar programs in the future. Another purpose was to understand the attitudes of participants toward scientific research and levels of civic engagement. Although anonymized feedback may lead to more honest feedback (Antonioni, 1994), one limitation is that we could not track individual behavioral changes over time. Future studies would benefit from collecting personal information to evaluate specific changes in participants' attitudes toward science and to determine whether participation in the program leads to perceived changes in voting behavior.

Outcomes and Feedback

Figure 3 shows that our program has been largely successful in its aims. Over the course of a year of presentations at the Levy Center (December 2018–December 2019), the survey feedback ($n = 202$) indicates that 90% of survey respondents agreed that presentations increase their understanding of the topic, and 92% indicated that they will return to the program. During the course of the 13 months of the presentations when these data were collected, we enjoyed steady attendance of 7–20 participants per ses-

Table 2. Sample survey given to participants at senior centers after presentations	
Questions 1–5 were asked on a 5-point *strongly disagree–strongly agree* scale. Questions 6–7 were asked with a *yes–no* scale. Question 7a was open-ended.	
1	This program increased my understanding of the presented topic.
2	The presentation on the presented topic was helpful and engaging.
3	The presenters were knowledgeable about the topic(s).
4	Basic science is important and needs to be funded.
5	I am a consistent voter in local, state, and federal elections.
6	Would you be interested in further information on these topics?
7	Would you attend a similar program in the future?
7a	If yes, what scientific topics would you like to see covered?

a

This program increased my
understanding of the presented topic.

90%
strongly
agree or
agree.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- No response

b

Would you attend a similar program in
the future?

92%
say yes.

- Yes
- No
- No response

c

I am a consistent voter in local, state,
and federal elections.

91%
strongly
agree or
agree.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- No response

d

Basic science is important and needs
to be funded.

95%
strongly
agree or
agree.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree
- No response

Figure 3. Survey Feedback From 202 Responses Collected December 2018–December 2019 at the Levy Center

sion. Feedback collected from the Covenant Home (*n* = 132) was largely similar to that of the Levy Center, indicating the overall generalizability of the program: 78% agreed that the presentations increased their understanding of the topic, and 83% reported that they would attend similar programs in the future. The disparity between levels of agreement in the two centers may stem from the demographic makeup and cognitive abilities. We suggest additional research to directly investigate this relationship.

To further examine the program's reach and its potential impact on voting and science appreciation as specified in the aims, we asked participants about their voting habits and belief in the importance of basic science funding. Although this measure did not explicitly probe the change in these behaviors as a function of the program, it did allow us to understand the opinions of the audience. We found that our participants consistently vote in elections (91% agree), which agrees with the expected voting rate for this age group nationwide. Finally, we found that our participants believe in the importance of basic science funding (95% agree), which suggests that participants who already have interest in science (and therefore positive attitudes about science) may be more likely to attend our sessions. This predisposition

is an expected limitation, as our program is an optional event at each center. Future iterations of this program may include evaluation of how these results change in settings with less friendly preexisting attitudes toward science.

Lessons Learned

In creating SwS, we set out to answer the following questions:

1. What are effective ways to engage senior citizens with science outreach?

2. How can senior citizens benefit from science outreach?

3. How will science outreach affect the attitudes toward science and voting habits of senior citizens?

In the early years of SwS, we have been most successful at answering Question 1. Along the way, we learned several important lessons about this type of senior citizen–centered STEM outreach throughout its early years of development. Understanding the best way to tailor a talk to a given audience is crucial, and framing an argument is key in winning over an audience (Bubela et al., 2009). In early sessions of our program, we experimented with several formats to

understand which method works best. Some early talks tended to be too pedagogical and attempted to cover excessive detailed information. The result was a communication barrier between the presenter and the participants that prevented a productive conversation. Other early presentations tried to borrow aspects from STEM outreach and education designed for children, such as a number of interactive activities that involved mobility and dexterity (S. Laursen et al., 2007). Our training did not initially anticipate these population-specific considerations for an older audience, but several months of trial and error led to an optimal format.

We learned that the most useful format for everyone involved was informal talks with a large number of visual aids to reinforce complex concepts. As a result of this change, the participants have been consistently and highly engaged during sessions and have asked many questions throughout presentations. We encourage this type of interaction since it has marked a shift from a pedagogical to a conversational program. This type of interaction has led to successful outcomes in established LLIs because it promotes reflective thinking and more engaged learning (Lamb, 2011; Lamb & Brady, 2005). We are optimistic that this conversational approach of SwS will be similarly successful, although further research, as described below, will be needed to evaluate whether this format can lead to increased science literacy.

Additionally, we are starting new dialogues and forging new relationships that would not have been formed without SwS. Although our content has been primarily tailored to a lay audience level, we found that even participants with expertise in a certain area have been receptive to the content being presented. For example, a participant who was a retired biology professor was eager to contribute his own understanding on talks regarding CRISPR, GMOs, and antibiotics, leading to a productive and useful conversation where both parties learned something new. These talks are learning experiences for the presenters as well, and they often remark that the comments and unexpected questions that arise during the discussion portion of the session have led them to think about their research from a new angle and find clearer ways to answer questions. Frequently, participants asked questions that connected the presentation content to unconventionally related topics, such as news stories, personal accounts, and other types of science, leading to exciting new discussions. As a result, SwS sessions have evolved to become mutually beneficial dialogues for presenters and participants. One presenter summarized this sentiment, explaining,

> The prevailing mindset about seniors is that they can only understand so much. But my audience surprised me with so many technical questions and threw around terminology and technology that I had not heard of before. It was a learning experience that went both ways.

At this point, our program lacks a holistic answer for Question 2: "How can senior citizens benefit from science outreach?" Participating senior citizens have experienced a self-reported improvement in understanding of scientific topics, but there may be more benefits. As reported in prior LLIs, these types of lectures have the potential to improve cognitive ability, self-esteem, and overall well-being (Brady et al., 2013; Lamb & Brady, 2005). It would be interesting to understand whether SwS offers benefits beyond increased appreciation for science. For example, could these lectures be incorporated into a more holistic curriculum or integrated into other LLIs for maximum overall benefit?

Finally, further work is needed to rigorously probe Question 3: "How will science outreach affect the attitudes toward science and voting habits of senior citizens?" In this article, we have described the development of SwS as a sustainable STEM outreach program. A logical next step would be to establish a science education research project using SwS as a platform to investigate its role in science literacy and voting habits. Surveys before and after presentations could serve to measure changes in scientific understanding. This step could be further supplemented by asking questions addressing specific aspects of the topic to obtain a more accurate and non-self-reported way to probe scientific literacy. To date we have collected only anonymized feedback, but collecting personal information could enable us to track individuals' progress to measure long-term improvements in science literacy. To measure changes in voting behavior, which could be difficult to directly probe, we might ask supplemental questions after an

election to understand whether the presentations had any perceived impact on participants' decision-making process, especially about science-related issues.

With the results and lessons gained from SwS, we can put forth several recommendations to guide future STEM outreach programs that seek to focus on older adult populations:

1. Seek community partners with goals that align with program goals, such as established LLIs.

2. Spend the necessary amount of time on training presenters prior to sessions to maximize the potential impact of the content.

3. Make time to chat informally with residents before and after presentations to humanize scientists and build relationships.

4. Foster a dialogue between the presenter and participants by creating a comfortable space for questions and discussion.

5. Seek suggestions for program improvement from both presenters and participants.

Future Outlook

In addition to the methods outlined above to probe the original questions more rigorously, we plan on partnering with more senior centers and incorporating more medically related talks (which have been heavily requested) by recruiting more presenters from the NU Feinberg School of Medicine. Based on our success establishing this program in multiple locations, we are optimistic that this model can be expanded to other locations, such as public libraries or community centers, to reach a broader audience of voting-age adults. We are also in the process of making presented talks available online so that participants can access this information after the sessions and can continue the conversation about science elsewhere. These online resources would be accompanied by an optional online version of the survey to evaluate any learning that occurs beyond our direct presence. A long-term vision for this program is that these conversations will expand and proliferate beyond presentation sessions so that participants talk and think critically about science as they encounter it elsewhere in their lives, such as on the news or in the voting booth. We are exploring other ideas to build more actively engaging environments. These formats include distributing reading guides or case studies to participants beforehand and having participants lead small group discussions after presentations.

As an additional benefit, the SwS program improved science communication skills of the presenters. Although we did not explicitly measure this improvement during the early development of SwS, we have received unsolicited anecdotal feedback from presenters, along with the tendency for presenters to talk and take part in SwS multiple times: 31% of our presenters return to the program and give more than one presentation. As a result, we have recently begun to monitor this trend by distributing open-ended surveys to collect self-evaluations from presenters. Table 3 shows some early

Table 3. Presenter Feedback
"The prevailing mindset about seniors is that they can only understand so much. But my audience surprised me with so many technical questions and threw around terminology and technology that I had not heard of before. It was a learning experience that went both ways."
"I've been working on outreach for a while now and this definitely reinforced my belief in the importance of disseminating scientific findings to a broader audience."
"SwS has made me realize how important (and difficult!) it is to explain your research in accessible terms and to make the topic exciting/relevant to others. I also feel more confident in my speaking skills!"
"It really showed that sci comm is much more versatile than I generally think—you truly do have to cater it to audiences."
"I realized that outside of classrooms and scientific conferences, it's important to take a step back from detailed explanations and focus more on what research has accomplished and why it is important."

feedback from presenters from personal experiences with SwS.

Academic education of graduate and post-doctoral researchers tends to emphasize research communication to peer scientists over presentation skills for lay audiences. By presenting with SwS, volunteers gain valuable communication skills and experience for tailoring science talks to people with a wide range of science backgrounds. Providing these tools to early-career scientists and engineers will advance the urgent task of continuing to grow the network of scientifically literate voting-age people. The communication skills that presenters develop during SwS sessions are likely to help them in future outreach events and in professional contexts beyond science outreach (S. L. Laursen et al., 2012).

Finally, we plan to encourage more general feedback about the program to further improve SwS. By engaging all participants, including presenters, in shaping the program, we can meet mutual needs and increase the program's impact on the community. We hope that SwS will continue on its path of sustainable long-term growth while being viewed by the NU community as a useful learning experience valuable to all STEM researchers and by the broader community as a trustworthy, accessible, and engaging program.

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Acknowledgments

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Role Model Moms Post-Secondary Academy: A University-Community Collaboration to Encourage Access to Postsecondary for Marginalized Women

Roxanne Wright, Tianyue Wang, Casey Goldstein, Danielle Thibodeau, and Joyce Nyhof-Young

Abstract

The Role Model Moms (RMM) program supports low-income mothers completing their General Equivalency Diplomas. Postsecondary education (PSE) can break cycles of intergenerational poverty; however, existing PSE orientation resources were not designed for this group. A need existed for a new university resource utilizing a collaborative and community-engagement approach to provide tailored information on PSE for RMM participants. The RMM Post-Secondary Academy was developed to bridge this gap. It was evaluated via facilitator debriefing sessions, post-event surveys, and participant interviews, with results analyzed using basic statistics and descriptive thematic analysis. The event has run for three iterations, inviting 42, 45, and 38 women, respectively. Participants improved their understanding of and outlook on PSE. Their PSE concerns included family, financial, and academic barriers. This event provides a replicable model for responsive and cost-effective community programming. Community engagement ensured the content was relevant and applicable to the target audience.

Keywords: marginalized populations, cross-institutional collaboration, women, general equivalency diploma, grassroots

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Education, especially higher education, has the potential to positively alter the course of a life, and to interrupt intergenerational cycles of poverty (Wagmiller & Adelman, 2009). Accessing a postsecondary education (PSE), however, for those who would most stand to benefit from it, can be a herculean task. For a candidate from a marginalized group (or multiple marginalized groups), the social capital required to select and apply to a postsecondary program presents a considerable barrier. Postsecondary institutions, even when they do focus on improving access, often take for granted the challenges of navigating the process, including deciphering jargon, anticipating deadlines, and finding the right points of entry (Lin et al., 2001, p. 6). Add in the challenges of sorting out financial aid and housing, childcare, the complexities of pursuing education for candidates reliant on any kind of social assistance, or additional considerations for candidates with complicated citizenship status, and aspirations can quickly dissolve for even the most determined applicants. These factors, however, raise important questions: Where can institutions intentionally address barriers that prevent candidates from marginalized communities from benefiting from fully accessible PSE? What would progress in this area look like?

This article describes the development, implementation, and evaluation of the Role Model Moms Post-Secondary Academy event. A grassroots collaboration was formed between diverse University of Toronto units, faculties, and departments, various other local colleges and universities, and the City of Toronto Social Services

department. An event was developed with the aim of providing tailored information, support, and encouragement to reduce barriers in the pursuit of PSE after graduation of RMM participants. This event provides a replicable model for responsive community programming by postsecondary institutions, with the aim of providing equitable access and opportunity to an underserved population, to ultimately improve their potential for future employment, financial stability, and health.

Background

The University of Toronto (U of T), along with the Role Model Moms (RMM) program, led the initiative to develop a new higher education orientation resource targeted toward this marginalized group.

The University of Toronto

Leading the initiative is U of T, Canada's largest University, with over 90,000 students and over 21,500 staff and faculty members, spanning three campuses. The university offers undergraduate, graduate, and professional programs, and stands as a "global leader in research and teaching" (University of Toronto, n.d.).

Role Model Moms

The RMM program is a unique not-for-profit educational program that supports marginalized women who face multiple socioeconomic barriers to completing their General Equivalency Diploma (GED), a high school certification equivalent. Two community-based program sites are staffed by provincially licensed teachers with backgrounds in community development, along with trained childcare workers. These two program sites are located in Glenfield–Jane Heights and Victoria Village, neighborhoods in the northwest and northeast comers of Toronto, respectively. Though participant demographic data was not collected, demographic profiles of those neighborhoods offer some insight into the communities that RMM serves (Table 1). Both neighborhoods report higher unemployment and poverty rates than the city average, and greater numbers of people who identify as immigrants and speak a language other than French or English at home. Most tellingly, education attainment rates in these communities differ from city-wide rates. In Victoria Village, 12% of the population has no educational certificate, compared to Toronto's 10% (City of Toronto, 2018b). In Glenfield–Jane Heights, 31% of residents have no educational certificate (City of Toronto, 2018a).

Program participants reflect these community demographics and are diverse in terms of age, ethnic background, country of origin, immigration status, prior educational attainment, family composition, and future aspirations. All have a common desire to make a change in their lives and improve outcomes for themselves and their children. Students are held to high expectations for attendance, effort, and commitment to the program.

Table 1. Community Demographics			
Demographic	**Community (%)**		
	Glenfield–Jane Heights	**Victoria Village**	**Toronto Generally**
Women	53.3	53.4	51.9
Visible minorities	76.6	59.1	51.5
Immigrants	58.9	53.5	51.2
Home language nonofficial	38.8	31.7	29.2
Poverty (Market Basket Measure)	27.4	25.6	21.9
Unemployment	11.5	10	8.2
No certificate, diploma, or degree	31	12	10

Note: Source: City of Toronto (2018a, 2018b).

Responsive Community Engagement

The initial collaboration between RMM and the University of Toronto was made through the organization's work providing service-learning placements for medical students in their foundational training years in the MD Program. All MD Program students participate in a service-learning placement organized by the MD Program's Experiential Learning Lead. These longitudinal placements, which are not clinical, explore social determinants of health via in-class and hands-on modalities. The partnerships developed for these placements are typically retained year to year.

The genesis of the Post-Secondary Academy event was organic. In 2016, an RMM teacher approached the Experiential Learning Lead (RW) to request a campus tour for her students. Unfortunately, available university tours were aimed primarily toward young, first-entry students with the intention of helping them choose which institution to enroll in. They lacked orientation to resources for first-generation students (i.e., first in their family to attend PSE) and those with family responsibilities. They did not provide information about PSE options, how to navigate the university or college services, nor customized messages for students unfamiliar with the culture and language of PSE. This presented a unique opportunity for the Experiential Learning Lead to create something new, with resources specifically tailored for this group that could be delivered within strict financial and time constraints.

What emerged was a cross-campus, cross-institutional collaboration that capitalized on the knowledge and expertise of individual staff and faculty, the in-kind resources available at U of T and other institutions, and other supports already available to participants. In May 2016, 42 mothers and their children attended the first Role Model Moms Post-Secondary Academy event at U of T. This event—a collaboration between 12 faculties/units/departments at U of T, several Toronto postsecondary institutions, three student groups (including student parents), and Social Services staff from the City of Toronto—welcomed RMM students to explore the campus with their children and to receive focused information about pursuing higher education. Relevant information, programs, and resources that parents with their specific needs could make use of were highlighted. Additional itera-

tions in 2017 and 2018 served groups of 45 and 38 women, respectively, with a similar model.

Capacity Building

The president of U of T outlined priorities for the institution, one of which is "leveraging our urban location . . . for the mutual benefit of university and city" (Gertler, 2015a, para. 1). To maintain this priority, he stated an obligation to "work collaboratively with other entities outside the University to address urban challenges and opportunities" (Gertler, 2015b, p. 8), and a goal was set to "enhance the visibility of and access to" the programs offered (p. 7). A normal route to resolving a service gap with a permanent solution at a large institution involves heavy investments of time and multiple layers of buy-in, as well as financial and other resources. In this case, the desire to respond to a present community-identified need created different conditions and presented different considerations. Within the MD Program, it was unlikely that a new role or unit would be created to address access and equity for this group for several reasons, not the least of which was that a GED is many steps removed from pursuing medical education. It is logical and prudent for departments at a postsecondary institution to maintain a focus for their work, and to operate within established frameworks most of the time. Access programming in particular is often subject to restrictions on who is served, due to either programming or funding mandates. Marginalized groups may have immediate needs but may not have resources on campus that quite address them in the right way. In this case, a gap was identified whereby existing university orientation resources did not address the specific needs of the RMM demographic. As a result, the question arose: What if there were a way to respond creatively to community requests, using minimal resources and with minimal strain on current resources?

The Experiential Learning Lead contacted her network of campus colleagues whose roles directly interacted with community, access, equity, and student success initiatives, to determine whether addressing the needs of this particular group through existing channels would be possible, and if nobody was currently working toward this, perhaps something new could be created. Those approached were enthusiastic to address this community request to bridge a

clear gap in the existing services for vulnerable populations and felt their services and roles could be tailored to this particular audience. An interdepartmental group was formed comprising staff from the Faculty of Medicine, Kinesiology and Physical Education, Arts & Science, Financial Aid, the Career Centre, the Centre for Community Partnerships, First Nations House, First Generation Students programs, Family Care Office, the Faculty of Education, Alumni Relations, and Hart House.

A group of approximately 12 staff members and the two RMM teachers met to discuss what could be accomplished to develop a community engagement approach to plan this initiative. Community engagement is a "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" (Centers for Disease Control and Prevention, 1997, p. 9 (Centers for Disease Control and Prevention, 1997). The group recognized the need for community expertise in understanding community needs, and the importance of collaborating with community members when planning interventions that affect them (NICE, 2016). It decided first to engage with RMM students to set the agenda, and a presession meeting with RMM students was conducted to understand the optimal event mandate, structure, and content.

Methods

Event Planning

Event Planning With Staff and Faculty

Several 60–90-minute planning meetings were held in the weeks prior to the event. Attendees contributed planning ideas and volunteered for tasks compatible with their interests, expertise, or position (CCPH Board of Directors, 2013). Staff unable to attend these early meetings were still able to support the event. This flexibility encouraged varying levels of buy-in and participation, and more people were able to contribute (NICE, 2016). The Experiential Learning Lead acted as the central coordinator for the large group of facilitators. In this somewhat laissez-faire collaborative approach, the Experiential Learning Lead became the person to whom other planning members were accountable. In this role, responsibilities included keeping an email list of those interested in involvement, circulating detailed meeting minutes, and acting as the central coordinator for questions regarding tasks and email updates.

Presession Meeting With RMM Students

The 90-minute presession meeting with RMM students was conducted before each event, given each cohort's unique needs (Brunton et al., 2017). The sessions were intentionally hosted in RMM classrooms, to ensure comfort for the participants to ask questions freely and openly. The sessions were facilitated by the Experiential Learning Lead and others in the planning committee, depending on availability. Facilitators asked students what they would like to learn. Students wrote their questions and concerns about PSE on sticky notes and stuck them to large pieces of chart paper. Facilitators answered some questions and brought the rest to the planning group to inform the event itself. Over three iterations, a number of consistent questions and themes appeared: how to finance an education while receiving social assistance/dealing with bankruptcy; how being a student impacts housing or childcare subsidies; how to apply to school as a noncitizen or a non-native English speaker; how to translate a diploma or degree obtained in another country; and "What is the difference between College and University?" (In Canada, a college offers career-oriented education leading to a diploma or certificate; a university offers professional and academic programs that lead to a degree.)

In the first program iteration, the broad range of presession questions led to diverse invitations to participate in event planning and facilitating, as specialized knowledge beyond that of the U of T group was needed. The intention of the event, after all, is to provide insight and information for the RMM students as a diverse group lacking in foundational orientation to the mechanisms of PSE that institutions take for granted. It is not intended as a narrow recruitment device for U of T, but as an opportunity for students who may not otherwise have a space for these initial conversations to come and learn information that can help them to set and achieve their own goals. This goal exceeded the expertise and resources of U of T alone: Some of the RMM students' career interests were better served by colleges or other universities, and the complexities of finances and housing ar-

rangements required a knowledge of social service delivery beyond the capacity of any one university or college staff member. Staff from other Toronto universities (Ryerson and York); several colleges (e.g., Humber, Centennial, and Seneca); and community caseworker staff from the City of Toronto knowledgeable about childcare subsidies, social assistance programs, and social housing joined the team. In each case, staff and faculty within U of T had contacts at these other institutions and helped to reach out and invite their participation. Additionally, current postsecondary student–parents were recruited through U of T's Family Care Office as facilitators to provide mentorship and guidance from their lived experiences. Undergraduate student leaders and medical students in service–learning placements at RMM were recruited to support children's activities and group discussions.

Structured Planning and Communication With the RMM Teachers

The Experiential Learning Lead and RMM teachers organized the full event and its promotion. This included creating the overall event agenda, organizing lists of RMM students and their children, arranging childcare, and obtaining signed liability forms. By necessity, the community partner was an active participant in this planning process; no major decisions were made without their involvement to ensure that the event met the needs of the RMM students and teachers (CCPH Board of Directors, 2013).

Location Scouting

Hart House, a unique and historic campus resource that is a part of Student Life, offered to help provide space, food, and staff for coordination and facilitation (NICE, 2016). Hart House is a beautiful, historic student center and public space with a mandate to support community initiatives and promote equity and social justice on campus. Their in–kind involvement and support were invaluable to the success of this initiative.

Childcare Coordination

Presession meetings and RMM teacher consultations emphasized the importance of the provision of childcare in RMM students' decisions to attend this event. Further, the NICE Guideline *Community Engagement* (2016) suggests providing supports, such as childcare, to remove barriers and encourage community involvement. Childcare for toddlers to preteens was provided by program staff from Hart House and Camp U of T, a program of the Kinesiology and Physical Education department, and staff from the campus Early Learning Centre. Student volunteers also supported childcare providers. Older children were invited to attend the event to learn about PSE with their mothers. This approach reduced attendance barriers while explicitly welcoming participants as parents with families; it also aimed to emphasize to the participants' children that postsecondary is a welcoming place for them as well.

Event Delivery

Making the Event a Comfort Zone

RMM classrooms are a significant distance from the university, and their students and teachers are not necessarily familiar with campus. The "welcome" began at the subway station; staff and faculty met with the group and walked with them to Hart House (15–20 minutes at a leisurely pace). The group followed with an unstructured time for getting settled (NICE, 2016). Coffee and treats were offered, and childcare staff and volunteers were present as RMM students arrived. Those mothers whose children would participate in childcare saw them off, staff and faculty introduced themselves, and RMM students settled in for the event.

Overview and Discussion Tables

An overview of the event was given by facilitators, and general introductions were made. The group then separated to different discussion tables (NICE, 2016). Discussion was grouped into themes that responded to presession questions, including the life of a student parent, finding support, and navigating postsecondary education. Staff and faculty were seated at tables corresponding to their areas of expertise, along with current student–parents and a volunteer "timekeeper" to facilitate discussion. RMM teachers had previously divided students into groups, and each group rotated between tables at set intervals to ensure that they were able to seek out key information on each topic.

Panel Discussions

Subsequent event iterations included panel discussions, based on RMM student feedback and presession questions. Participants felt there was so much to learn that they wanted to ensure some consistent large group information delivery along with individualized information. Panel topics have included information on a Centennial College program specifically for students whose high school educations were incomplete but who wished to enter PSE, financial aid and social assistance information, campus supports for parents, application processes for specific college programs, how to support your child's application to PSE, transitional year and academic bridging programs, and city resources for families. During the lunch that followed, RMM students could connect with a staff or faculty member whose work was of interest. Table discussion prompts were available to support these conversations.

Closing the Event

RMM staff and the Experiential Learning Lead offered brief closing remarks and thank-yous to the group and its organizers. An evaluation survey was administered to participants, usually with a prize or incentive for survey completion. Next was a resource fair. The resource fair structure has varied over different program iterations. In the second iteration, an informal resource fair was offered, where staff and faculty who wished to share more information about specific resources or programs brought their resources and made themselves available for discussion. In addition, in the first iteration of the event, a small tour of campus was offered as the group was led to the subway to depart.

Program Evaluation

Evaluation Surveys

Each year, a quantitative, semistructured survey was administered immediately postevent to all RMM students and teachers, and a prize drawing was performed after all responses were submitted. The surveys asked participants to rate different aspects of the event using a Likert scale and included comment boxes for feedback and recommendations. Areas assessed in the surveys included stage of progress in GED program, satisfaction with and usefulness of event activities, and postevent attitudes and outlooks on PSE.

Debriefing Session

A few weeks postevent, the Experiential Learning Lead convened a meeting of the event facilitators and planning committee to discuss what went well and what needed work, and to obtain feedback from the group about the event. Results informed changes to the subsequent year's structure.

Participant Interviews

Approximately 6 months following the first and second iterations of the program, semistructured 20-minute interviews with a convenience sample of two participants per iteration were conducted in English by an RMM teacher. During the interviews, participants were asked about their experiences during the RMM Next Step Academy event at U of T; the interview questions are included in Appendix A. The interviews took place at the RMM classroom, and participants were consented and interviewed by the RMM teacher. All participants gave verbal informed consent for the interview. The interviews were audio recorded and transcribed. Subsequently, the audio recordings were destroyed.

Data Analysis

All survey results were analyzed using basic descriptive statistics. The interview transcriptions were descriptively coded and sorted according to themes developed by the researcher TYW, which were verified with coauthors (RW, JNY) multiple times to ensure analytic rigor.

Ethical Considerations

This project was exempted from ethics review by the University of Toronto Research Ethics Board due to the quality improvement/quality assurance focus of the program evaluation study.

Results

In the first, second, and third iterations of the event, the survey response rates were 67%, 36%, and 42%, respectively. Interviews conducted following the 2016 and 2017 iterations consisted of four participants representing the RMM group's diversity, including a student completing her GED, a student who had graduated from

the GED program but had not yet applied to a postsecondary program, and two women with foreign postsecondary degrees.

Participant Characteristics

The attendees were diverse in their stage of progression through the RMM program and GED attainment. The 2017 survey results indicated that 56% of students expected to complete their GED within 3 months, 31% had already received their GED and were eligible to attend postsecondary in the next available application cycle, and 6% expected to complete their GED within 3–6 months.

Event Ratings

Informally, the feedback received from RMM instructors indicated that the program was very well attended, with the majority of enrolled RMM students present. Some students who had already graduated from RMM also attended, and some brought friends and family members who were not enrolled in RMM. Survey results from the first and second iterations indicated that over 85% of the students described their experience as excellent overall, with none scoring the event below average or poor. In 2016, 79% of respondents felt welcome on campus, 93% considered the event a good use of their time, and 89% found the information presented useful. In 2017, 80% of survey respondents agreed or strongly agreed with the statement "I am more likely to consider PSE," and 100% agreed or strongly agreed that they felt more prepared to pursue PSE. Further, 100% of 2017 respondents agreed or strongly agreed that the event is a worthwhile initiative, and 100% agreed or strongly agreed that they had experienced positive changes in their understanding of PSE financing, available supports, and contacts at postsecondary institutions.

Qualitative Themes

Analysis of postevent interviews provided a list of common challenges facing RMM students' pursuit of PSE (Table 2), including (1) family barriers, (2) financial barriers, and (3) academic concerns. Interview and survey results indicated that the event addressed some participants' concerns regarding these barriers. All participants noted that the event helped them to feel that PSE was possible for them. Interviewees expressed that they learned about the resources available to them and described the event as "empowering" because of their encouraging interactions with the event staff and current student–parents.

Feedback

Specific event feedback was elicited from the RMM participant interviews (Table 3). All participants believed that PSE is right for them and indicated that the event helped them see that it is a possible and achievable goal. Some RMM students were able to clearly articulate their goals and the path to achieving them following graduation from RMM. However, for some participants, individualized follow-up guidance was needed to help follow through on their specific goals. RMM students who were potentially the first in their family to attend PSE were less able to set out career goals. Among this latter group, a specific need for career counseling emerged in both the surveys and interviews. An often-repeated question was "How do I pick the right program for me?" Often, few people in their family and social support networks have attained PSE, so these women may lack adequate exposure to the different careers available with a university degree or college diploma. More information regarding how to learn about and explore different career paths would likely benefit this group.

Although the RMM program and this event intend to equip participants with resources and information to support their future pursuits, it must be noted that this support is limited by the necessary fact of participants' graduation from RMM. All staff and faculty who participated in the event provided their contact information to all attendees for future follow-up, but a comprehensive mechanism for continued support exceeds the reach of both the event and the RMM program.

Cost Assessment

The event proved to be cost-effective. Space was donated, and staff did not incur additional costs for their time. Total costs for childcare and food, including lunch, snacks, and coffee for approximately 40 RMM students and their children, plus 30–35 staff and volunteers, was approximately $1,000 CAN ($760 USD), or around $13 per person. These funds came through Hart House, with the Faculty of Medicine covering half of the costs in the third iteration. Other consumable items used, such as folders, informa-

Table 2. Common Barriers to PSE Among RMM Students		
Theme	**Topics**	**Participant quotes**
Family barriers	Balance between role as mother and as student	"I never thought that when you're a parent you could go [to postsecondary]. You have to think about your kids, you have to look after them and prepare them and you stop preparing yourself . . . when you have kids, you're done."
	Experience as a student–parent	Participants spoke with staff and current student–parents about supports available and personal experiences. "I looked at [one of the staff members] and I thought, you don't look much older than I am. If they can get to school, then I can do it too. So that was part of my motivation."
	Logistics of childcare and accommodations for unexpected circumstances	"I didn't think that they have that house for, like, if you got kids, and they even have daycare in the university, so it's super helpful." "I want to know what happens if I have a problem or I get sick."
	Impact on children	"They encouraged that parents should not stop; they can continue looking forward, and they can tell their kids, 'You can do whatever you want.' As a parent, we can show our kids and . . . they will be better people."
Financial barriers	Impact of tuition on family finances	"I know for me personally, I wasn't at that financial point . . . to attend postsecondary. If I went to school, how would my son. . . . I don't have a job. I wasn't prepared to go right away."
	Require clear breakdown of educational costs	"I want more details . . . how much it costs and how you support yourself. I'm ready to do anything if someone breaks it down for me. I don't want debt if I am not going to have a job, I have three kids to feed."
Academic concerns	Differences between college and university and how to pick a postsecondary program	Increased awareness of options and flexibility of PSE. "That one day . . . changed my perspective. Even to do a short course . . . you don't have to do a four- or five-year big thing. So, it kind of changed the way I looked at going back to school, whether it was college or university."
	Risk of poor academic performance after investment of time and financial resources	"How I'd get help in the school, like, if I don't know how to do an assignment, is there someone to help? What academic support[s] are there?"
	Transition year programs	"I didn't see myself in university, but after . . . I thought maybe I could do it. Especially for the transitional year. Because I know I cannot run into university like that, I think I needed that."
	Bridging programs	"It's not just like, go in and if you fail, you're just so disappointed . . . you can start with college and then you can go [on to university]."

	Aspect of Event	Feedback and Participant Quote
	Table 3. Event Feedback From Interviews and Surveys	
Strengths	Childcare	Allowed participants to attend event given their childcare responsibilities. "The way you handled the children, I really appreciated that. Persons took their children and they were well taken care of. It's a very good thing, so you can reach out to more people when kids are playing."
	Interactive structure	Able to speak to different facilitators about experiences and expertise. "It was a great opportunity to visit U of T. . . . I would never have thought [I] could go to the university and meet with the people who work there and all of the things they thought to prepare for people who didn't think they had the resources to go to university."
	Written materials	Allowed participants to review for the future. "The way we had brochures for future reference [worked for me]."
	Positive change in participants' opinions of whether PSE is a suitable option for them	Event addressed specific concerns and barriers (Table 2). "I didn't expect I would find out things that would help me as a young single mom. . . . I would have thought, honestly, 'You can't do it, it's not for you,' . . . but I found out they have many ways, you can, you can do it. So I'm glad I went because I learned many things I didn't know."
Areas for Improvement	Lack of structure at discussion tables	With multiple RMM students sitting per table with staff, it became difficult to address all participants' concerns. "I couldn't get my point in . . . and one person would talk more than one person." "When people are in a big crowd . . . you don't get much out of it." Information given at each discussion table varied depending on the questions asked by RMM students. More structure to consistently communicate information relevant to most students (see Table 2). "It should be more general during the main part, [with] specific questions at [the] end."
	Time	Not enough time to have all questions fully answered during the event. "I needed more time with the different workers, like there was social workers, I think, financial workers, Ontario Works people, and I didn't get the chance to [discuss] one and one with all of who I wanted."
	Written materials	Participants would appreciate financial and childcare information in written form. "I would like to see everything written down."
	Need for individual counseling	"Maybe if there could be booths. . . . it's my time to go sit down and talk to the person one–on–one. They wanted to talk by themselves and they didn't get the chance to express what they were going through. So if they could put a personal touch, like I could sit and say this is what is going on. How would I do? How would I go?"
	Need for follow–up guidance	"That day was like an engine turned on, everyone was so happy, it was unbelievable, to know you can actually go there. All the fire that was that day, the emotional moments, they pass. It's time to move on it right away, to keep on inspiring them and not let it finish."

tion printouts, name tags, and pens, were gathered from the organizers based on availability (e.g., extra folders and name tags from a prior conference, promotional pens and notepads from a department or institution). Other novelty items, such as keychains, t-shirts, and tote bags, were provided as they were available, which RMM students appreciated.

Discussion

Implications of Early-Stage Assessments

Formal interview and survey feedback, as well as informal feedback, indicated that this event provided a valuable opportunity for mothers attaining their high school equivalency diplomas to explore postsecondary options with explicit acknowledgment of factors such as income, family responsibilities, academic background, housing, and immigration. Attendees appreciated the opportunity to be supported and encouraged by staff who had knowledgeable answers to their questions. The presence of multiple institutions was helpful to promote an understanding of the conceptual differences between college, university, and professional training programs, and to clarify the value of high school diplomas in relation to future goals.

The RMM student group is unique in lacking the kind of cultural capital common among students entering university. Although first-in-family and mature applicants do enter PSE in significant numbers, they are rarely the focus of information events. Finnie et al. (2012) indicated that for first-generation students, access to PSE is the principal barrier to attendance, and once enrolled, "they do at least as well as their non-first-generation counterparts" (p. 22). Our interviews and survey results indicated that prior to the event many participants did not think PSE was right for them; afterward, however, they expressed feeling better prepared to pursue PSE and that it was a viable option. Education, along with factors such as role models and employment opportunities, are key "poverty exits" and can contribute to the ability of individuals to break intergenerational cycles of poverty (Wagmiller & Adelman, 2009).

The Role Model Moms Post-Secondary Academy event is a replicable model for responsive community programming. A nimble, diverse team, composed of individuals from relevant departments and institutions under the leadership of a central coordinator, can work efficiently to create the event and its components. Existing networks, formal and informal, are helpful in creating this team. Each team member selected tasks they already had expertise and skill in, and preparation time is quite minimal. The central planning group can accommodate members from any department or unit, at any level or stage in their career. In terms of leadership, having one team member focused on overall coordination of all activities and one team member focused on logistics and coordination on the day worked very well. Though most hours were invested in this project closer to the event date, there was no point at which work on the event impeded normal job duties for any team member.

Recommendations

To successfully replicate this model at other institutions, we offer our recommendations and lessons learned:

- **Campus community leadership**. Community leadership within the campus community was a key factor in the success of the program. Success of the program's first iteration rested upon the ability of the program's leads to identify supportive partners within departments at U of T and outside the university. Fostering professional communities and collaborative practices within an institution is vital for allowing this type of organic, responsive programming to take place.

- **Community involvement**. The impetus for holding this event came from the community, not from a postsecondary institution. By reaching out to RMM participants before the event to learn about their needs, we ensured that we had the right people involved, and that the information and support they provided was relevant and specific.

- **Cast a wide net**. By reaching out to staff and faculty from multiple departments and institutions, the level of specific information we were able to offer was high. Further, we provided a strong, responsive, and useful program for diverse at-

tendees by including people outside our own institution.

- **Program evolution**. The overall intention of this event—to introduce, welcome, and enroll women who are traditionally discounted from higher education—will take an investment of time. As we continue to program for this group, we continue to learn about additional support and circumstances that make for more successful outcomes. Our event, in conjunction with the supportive programming that RMM students receive through their program, is intended to provide a foundation for PSE.

- **Continued support**. We believe it is key for postsecondary institutions to continue building the supports that marginalized students need when they actually enroll. Enrollment in a postsecondary institution is just the first, often difficult, step in achieving higher education; continued support and networking are crucial for the successful completion of a chosen program and ultimately for securing employment after graduation. Providing all participants with contact information for all staff and faculty at the event is important. It would be useful to consider ways to continue to provide direct application and exploration support to participants, though this exceeded the capacity of our particular event.

- **Long-term evaluation**. The long-term impacts of this program on participants and their families may take years to be fully realized. One-year follow-up interviews with participants may usefully track out-

comes, as well as identify ongoing barriers holding them back from attaining their goals. Two RMM student attendees have since enrolled in postsecondary programs, and shared that they found out about these programs and met the relevant contacts at the event.

Conclusion

The World Health Organization (2011) stated, "Education is a human right [and] enhances people's capacities to have decent jobs and fulfilling lives"; furthermore, "education provides vital skills and knowledge that influences well-being directly and indirectly" (p. 2). In response, postsecondary institutions are challenged to provide equitable access to all learners. The Role Model Moms Post–Secondary Academy event was created to help provide equal access by introducing tailored information on PSE options to a marginalized group of women that included student–parents, first-generation students, and mature students. The innovative approach to responsive community programming used in the planning and delivery of the event drew on the skills and expertise of a wide range of facilitators, faculty, and staff from multiple institutions and departments, resulting in a specialized resource delivered with limited financial and time expenditures. Involvement of the target audience from start to finish is an integral part of developing a program that is actually relevant and applicable to the specific needs of the group. Positive participant feedback suggests success for a program aiming to provide access and opportunity, and ultimately improving the long-term outcomes of participants and their families. As one participant noted in her interview, "Keep going so we can have more hope and not just settle for less . . . think big."

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Appendix A. Participant Interview Questions

Tell me about your experience at the event. What was it like?

What worked for you and what didn't work for you at the event?

How did the event work with your kid(s)?

What did you think you were going to get out of the event before you went to it?

What did you actually get out of attending the event?

How did your opinion change about what it is like as a parent–student attending post-secondary schooling?

Was there any change in how prepared or not prepared you felt to go to post-secondary school?

How did/did this event change whether you thought post-secondary was right for you and your family members?

How does this event change what you and your family members are going to do, if anything, about post-secondary schooling?

If you came to this event next year, what would you want to know more about?

Is there anything else you want to add?

Exploring Effective Pre-Kindergarten Family–School Partnerships: The Pre-Kindergarten Parent Leadership Academy Program

Daniela M. Susnara, M. Blake Berryhill, Andrea Ziegler, and Alex Betancourt

Abstract

Research suggests that positive parent–teacher relationships and increased parent involvement can improve student achievement. Family–school–community partnerships can promote these outcomes. This article describes the Pre-Kindergarten Parent Leadership Academy (Pre-KPLA) within the Parent Teacher Leadership Academy (PTLA) at the University of Alabama. To support local elementary schools and their students and families, the Pre-KPLA gives parents the opportunity to develop leadership skills within their school community while promoting parent–teacher relationships. Using a mixed-methods design, we analyzed data from the 2017–2018 and 2018–2019 years of the Pre-KPLA on parents' leadership behaviors and self-efficacy. Pretest–posttest results showed that parent participants significantly increased their leadership behaviors and self-efficacy. Additionally, qualitative thematic analysis revealed that parents were inspired to take action in their school, gained new knowledge about school improvement goals, and learned new ways to seek additional funding for their school.

Keywords: parent involvement, family–school–community partnerships, community engagement

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The positive impacts of family–school relationships and parent involvement on elementary and middle school student achievement have been thoroughly documented (Henderson, 2007; Henderson & Mapp, 2002); however, research examining involvement of parents within early childhood education is still developing. The first 5 years of a child's life are critical to establishing a foundation for initial cognitive, social–emotional, and regulatory skills and competencies that, over time, will develop and provide function for the rest of their life (Shonkoff & Phillips, 2000). To some degree the skills and competencies can be measured by a child's preparedness to enter the formal school environment in kindergarten (Sheridan et al., 2010). Children with developed emotional and social skills have been proven to be more prepared for kindergarten (Sheridan et al., 2010). Barriers to readiness for kindergarten also exist for children faced with poverty, low parental education, parental mental health concerns, or living in a linguistically isolated household (Snow et al., 1998; Zill & West, 2001). To begin to overcome some of these barriers, the promotion of parental involvement and the expansion of family–school programs into early childhood education can better prepare pre-K students for elementary school (Sheridan et al., 2010). These programs can support parents to become leaders early on in their child's education by providing them with the tools and confidence necessary to fulfill this role.

The scope of parent and family engagement within schools is broad; however, a parent's leadership within their child's education represents one form of parent and family involvement in school (Cunningham et al., 2012). When parents are developed as leaders within the school, they are more likely

to be engaged and have a greater awareness of the challenges facing their child and the school community (Marschall, 2008). Parent leadership can appear in approaches that are either individual (e.g., advocacy on behalf of one's own child) or collective (e.g., participation in parent associations or councils, community involvement). When parents become leaders within the school and community, are they role models not only to their child, but also to other families (Cunningham et al., 2012). Further, when parents are taught the skills needed and gain the confidence to become a leader in their child's education and school, the degree to which a parent believes in themselves grows, increasing their school leadership self-efficacy.

A parent's school leadership behaviors and self-efficacy can be impacted by collaborative partnerships and parent–teacher relationships (Berryhill & Morgan, 2018; Berryhill et al., 2019). Raffaele and Knoff (1999) discussed the importance of developing these relationships, especially parent–teacher, during the preschool years when parents are formulating their initial roles and constructs in relation to their child's education. One way to build relationships at the preschool level is through collaborative partnerships. The National Association for the Education of Young Children (2019) identified teachers' preparation and parental support as essential in children's development. Their national standards include an emphasis on developing "collaborative relationships with each child's family to foster children's development in all settings" (NAEYC, 2019, Standard 7). Not only do collaborative partnerships initiate parent–teacher relationships and strengthen social–emotional outcomes for children, they also increase the efficacy and efficiency of interventions designed to foster supportive relationships both within and across home and school contexts (Grolnick & Slowiaczek, 1994; Masten & Coatsworth, 1998). Family–school relationship programs that encompass early childhood education have the potential to mitigate the long-term effects of known risk factors (Sheridan et al., 2010).

The importance of effective parental involvement and parent–teacher relationships in education are well documented in elementary and middle school settings (Epstein & Sanders, 2006; Henderson & Mapp, 2002). Positive parent–teacher re-lationships can affect children's academic outcomes and achievements (Hornby, 2000, 2011; Jeynes, 2005). Children whose parents are involved in their education and school are more likely to have enhanced academic performance and social skills, demonstrating a higher level of achievement (El Nokali et al., 2010; Pomerantz et al., 2007). These results are particularly true for children in early education (preschool and prekindergarten). Young children whose parents and families are involved in school exhibit gains in reading, math, and academic achievement (Galindo & Sheldon, 2012). Additionally, gains can be measured in the emotional and social skills of children in preschool and prekindergarten who have parents involved in school (Zhang, 2015).

Pre-K family–school relationships can be established through community partnerships. As with parent–teacher collaboration, NAEYC's (2019) standards state, "Relationships with agencies and institutions in the community can help a program achieve its goals and connect families with resources that support children's healthy development and learning" (Standard 8). One way to promote these relationships is through family–school–community partnerships that will promote student academic achievement and parent involvement (Epstein et al., 2011; Henderson, 2007). Community partnerships with local universities can provide schools with additional innovative ways to enhance student and school outcomes. When local universities form partnerships with schools, it creates the potential for increased resources and capacity building (Berryhill et al., 2019). The purpose of this article is to provide data on the University of Alabama's Pre-KPLA, a parent leadership professional development program that equips pre-K school parents to increase involvement and form school partnership teams for improving school and student outcomes.

Research Questions

The purpose of this study was twofold: (1) to evaluate the Pre-KPLA and its ability to increase parents' school leadership behaviors and self-efficacy and (2) to understand parents' experiences of involvement in the program. In order to assess these items, we addressed the following research questions:

1. Does the Pre-KPLA program significantly increase parent self-efficacy and

behaviors?

2. What were the benefits for parents of participating in the Pre–KPLA program?

3. How can the Pre–KPLA leadership support partnership teams in the design and implementation of their project?

Parent Teacher Leadership Academy Structure

The Pre–KPLA operates within the University of Alabama's Parent Teacher Leadership Academy (PTLA). The PTLA is a unique leadership program that provides research–based professional development to parents and teachers, as well as a structure for application of that new knowledge. The PTLA originally began in fall 2007 with only an Elementary Parent Leadership Academy and Elementary Teacher Leadership Academy. The PTLA now also includes Middle School Parent Leadership Academy, Middle School Teacher Leadership Academy, Hispanic Parent Leadership Academy, and, recently, the Pre–KPLA, conceptualized in fall 2015.

In addition to providing a clearly defined and structured professional development opportunity, the PTLA also offers graduates the opportunity for celebration with a final graduation ceremony, in which the University of Alabama's vice president for community affairs and school superintendents honor each team's graduates. In 2017 the academy began providing partnership teams the opportunity to apply for project implementation grants beyond graduation.

Conceptualized Through Partnerships

The University of Alabama's Center for Community–Based Partnerships is responsible for housing, organizing, and implementing the PTLA. The mission of the CCBP, an initiative of the Division of Community Affairs, is to connect faculty, staff, students, and community partners in research–based projects designed to solve critical problems identified collaboratively by community members and the university. In 2006 the PTLA was formed to increase parent engagement within the local elementary schools, a relevant need within the community. An initial advisory committee was developed to discuss and determine community needs. The Advisory Committee consisted of representatives from each of the partner organizations: the University of Alabama's College of Human Environmental Sciences, the College of Education, Tuscaloosa City Schools, and Tuscaloosa County Schools. Representatives included college deans, administrators, college vice presidents, local school superintendents, and federal program directors. Although the PTLA takes place outside school, benefits are expected to be shared back in the school and community to meet their specific needs. Frequently seen needs within the school communities are reading ability, attendance, and student behavior.

Partnership Team Nominations

Principals from participating elementary schools nominate team members to participate in the Pre–KPLA before the initial PTLA session. Each school principal ideally selects at least two parents and two teachers to participate in the school's partnership team. Within the Elementary Parent Teacher Leadership Academy, parents can be nominated for Elementary Parent Leadership Academy (EPLA), Hispanic Parent Leadership Academy (HPLA), or Pre–KPLA. However, all partnership teams must be made up of both parents and teachers. Principals are encouraged to nominate parents who have demonstrated leadership abilities or leadership potential, or who are currently active in supporting the school's mission. Parents and teachers who agree to participate in the academy attend leadership training sessions throughout the academic year and create a partnership team project proposal based upon a school improvement goal. Partnership teams agree to serve as the core leaders for the school, promoting school, family, and community engagement based upon research–based methods (Epstein, 2009; Henderson & Mapp, 2002).

Partnership Team Model

Family–school partnerships create the foundation of the Pre–KPLA. The mission of the Pre–KPLA is "building community by supporting children and families." A partnership team model is utilized in Pre–KPLA to support children and families in the school environment. Parents and teachers nominated by their school principal attend professional development sessions throughout the academy with an emphasis on leadership. These professional development sessions equip participants to serve as partnership team members. Intentional leadership training sessions provide parents

and teachers with a framework to utilize for family, school, and community partnerships. One Pre-KPLA parent described the sessions as providing a "great insight into ways to help prepare my children for various social and educational situations."

At the end of the academy, partnership teams share a partnership project proposal. The partnership project proposal is based upon a goal from the team's school's continuous improvement plan. To prepare the partnership project proposal, during sessions, parents and teachers begin to develop and collaborate on the project. Partnership projects are developed by parents and teachers to be specific, planned, and sustainable programs that are directly related to their school's curricular, behavioral, or cultural needs (Epstein, 2009; Mapp & Kuttner, 2013; Sanders, 2006; Sheldon, 2007). In order to present final partnership projects upon completion of the academy, parents and teachers must pledge to continue the work of their partnership team in between sessions. Additionally, beyond the final presentation, many partnership teams pledge to implement their partnership project back in their school. Academy facilitators and staff provide support and feedback to the partnership teams in between sessions. Additionally, the partnership teams report the progress of their partnership project proposal to facilitators and staff each month. This open dialogue between partnership teams and academy facilitators and staff promotes project completion and implementation.

Pre-KPLA Training Sessions

Pre-KPLA parent participants attend six professional development training sessions throughout the school year. Table 1 displays the session title, invited participants (parents, teachers, or both), and a glimpse of the session objectives. In addition to session objectives, each session includes time for networking with other parents, teachers, facilitators, and school administrators; leadership training presentations led by faculty members, community experts, school leaders, and past PTLA graduates; and time to create and collaborate on partnership team project proposals.

Graduation

All parents and teachers were recognized for their hard work, dedication, and partnership team project proposals during a graduation ceremony upon completion of the academy. Parents and teachers who consistently attended sessions and completed the partnership team project proposals were eligible for graduation. Principals, superintendents, school board members, staff from the Center for Community-Based Partnerships, the Division of Community Affairs, and University of Alabama faculty and administrators were all in attendance at graduation to recognize academy participants. At the graduation ceremony, graduates had the opportunity to display summaries and posters of their partnership team project proposals. Academy members were acknowledged for their contribution to their schools and given the opportunity to share stories about their experiences in PTLA. Each school received a plaque honoring the graduating academy members to display at their school.

Dual-Capacity Framework

Mapp and Kuttner's (2013) conceptualized dual capacity framework (DCF) provides the Pre-KPLA with a dynamic lens to investigate the utilization of family–school–university collaboration to support family–school partnerships and parent involvement. The DCF's nontraditional and broad structure provides a unique framework to explore parent–school partnerships (Mapp & Kuttner, 2013). An extensive view of parent involvement and multiple components of parent involvement are promoted through the framework. First, they are promoted through opportunity conditions. The DCF describes the opportunity conditions for building capacity through two types of subconditions: organizational conditions and process conditions. The participating school district's investment within the Pre-KPLA is linked to organizational conditions. Organizational conditions include conditions that are systemic, integrated, and sustainable. The professional development program embedded in the Pre-KPLA applies to the process conditions for capacity-building opportunities through sessions and parent–teacher team partnerships. Process conditions are often linked to learning, relational, developmental, and collective/collaborative.

Additionally, the DCF promotes policies and program goals, which are necessary to foster thriving family–school partnerships (Mapp & Kuttner, 2013). Policies and program goals should have a dual focus, not only on the capacity of families, but

Table 1. Pre–KPLA Training Sessions		
Training session	**Attendees**	**Session objectives**
1. Parents as leaders	Parents only	• Introduction to academy goals and objectives • Supports parents in their role of capable leaders who are making a difference in their school communities • Identify potential skills to reach other parents, teachers, and school administrators in solution-building discussions to improve their respective school communities • Supports participants' understanding of skills and knowledge required to be an effective parent leader within their child's school
2. Goal–oriented school, family, and community partnerships	Partnership teams (parents and teachers)	• Parent and teacher participants begin their collaborative work in their school teams • Epstein's (2009) six types of involvement (parenting, communicating, volunteering, learning at home, decision-making, and collaborating with the community) • Teams are provided opportunities to network and discuss their respective school's school improvement plan, to make a positive difference in the school
3. Helping your child achieve academic success	Parents only	• Supports participants' understanding of academic issues and building collaborative relationships with the school administration and PTA/PTO committee members • Parents network with other parents and individuals in the school community who can support academic success (i.e., teachers, school counselor, school psychologist, school librarian, other parents, etc.)
4. School and board of education relations	Partnership teams (parents and teachers)	• Understand the roles and responsibilities of school boards and school district leaders • Interactive panel with administrators and board members from participating school districts • Discuss the basics of school administration: finances, board policies and operations, and strategies to work with board members • Partnership team project planning time and feedback
5. Safe and healthy schools	Parents only	• Guest speakers lead information sessions encouraging parents to discuss learned health and safety practices with their children at home and to seek opportunities to share new information with their school's administration, teachers, and staff • Information sessions about child behavior management, physical and mental health, school safety, student wellness, and school disciplinary policies
6. Supporting connected and school communities	Parents only	• Parents learn about community resources that support families and schools and how to access these resources • Training in small-grant writing and project sustainability • Final partnership proposals and specific school initiatives are shared with peers to improve school climate and/or student academic success • Academy members have the opportunity to debrief with facilitators

also on the capacity of school personnel to engage in partnerships. The Pre–KPLA uses policies and program goals to build capacity for effective family–school partnerships. Capacity is built in Pre–KPLA through the implementation of the four components of partnerships capacity: capabilities, connections, cognitions, and confidence. The four components are explored below through the Pre–KPLA's professional development sessions and partnership team model.

Professional Development

Program sessions are used in Pre–KPLA to build capacity for parent–teacher partnerships. Goals of the sessions include increasing participant knowledge and enhancing skill-building needed to grow effective family–school partnerships. Secondary objectives of the sessions include sharing strategies for improving parent–teacher relationships and parent–parent relationships, and for building relationships with community organizations while purposefully developing trusting and respectful participant *connections*. Through the relationship-building process, the perceptions of parents and teachers are changed. Parents view themselves as partners in their child's education, and teachers view themselves as partners with parents to meet school goals. As the *cognitions* of parents and teachers adjust, confidence for engaging in family–school partnerships increases.

Partnership Team Model

The four components of partnership capacity (capabilities, connections, cognitions, and confidence) are met through the partnership team model, discussed in detail above. Over the course of the program, parents and teachers develop trusting and respectful *connections* with their partnership team. These connections are built while partnership teams build their *capabilities* of establishing effective family–school partnerships through the implementation of their partnership team model. During program sessions, parents' and teachers' *cognitions* about family–school partnerships are changed through the connection-building process, and, further, their *confidence* in engaging in family–school partnerships increases. Highlighting the four components of partnership capacity allows school personnel and families to engage in partnerships that will support youth development and ultimately academic achievement

(Mapp & Kuttner, 2013).

Methods

A mixed-methods design was employed during this study. Specifically, the goal was to examine the impact of the Pre–KPLA on parents' leadership behaviors and self-efficacy using multiple sources of data. The university institutional review board approved the study protocols. Additionally, all participants provided the appropriate consent.

Participants

Thirty-four parent participants took part in the Pre–KPLA during the 2017–2018 and 2018–2019 academic years. Parents were from 16 different elementary schools in three public school districts (31% rural, 50% urban, 19% suburban). All Pre–KPLA participants were female and all had at least one child enrolled in a public pre–K program at the time of the study. Over half of the parents were African American and married (64% African American, 71.4% married). All of the mothers with pre–K students participating in the study had received a high school diploma or higher form of education at the time of the study.

Participating District Snapshot

Participants represented 16 different elementary schools from three different school districts. The three districts represent three different school settings: urban, rural, and suburban settings. Within District A, pre–K students make up 4.63% of the student population. In Districts B and C, pre–K students make up 3.16% and 1.15% of their student populations, respectively. Additionally, Table 2 provides a look at the district's state report cards for the 2017–2018 and 2018–2019 school years.

Data Collection and Analysis

Research Question 1

School leadership behaviors and self-efficacy were evaluated using pre and post surveys. Surveys were distributed to participants during the first and sixth sessions for completion. The survey consisted of statements regarding leadership behaviors and school leadership self-efficacy, with participants responding on a Likert scale (1 = *never*, 2 = *very rarely,* 3 = *rarely,*

Table 2. District Snapshots					
		Year 1		Year 2	
	School type	Free & reduced lunch	State report card	Free & reduced lunch	State report card
District A	Urban	43.397%	80%	43.417%	83%
District B	Rural	48.229%	77%	46.548%	83%
District C	Suburban	33.251%	85%	35.088%	91%

4 = *occasionally*, 5 = *frequently*, 6 = *very frequently*). Examples of the seven leadership behavior items include "I get other parents involved in projects I'd like to implement at my child's school" and "I talk with other parents about being involved in my child's school." The 11 school leadership self-efficacy items included "I have the knowledge that it takes to be an effective parent leader in my child's school" and "I feel comfortable participating in meetings with teachers about school-related issues." We analyzed individual item and aggregate pre–post mean program school leadership behaviors and self-efficacy using paired-sample t-tests (see Table 3 for individual list of items and Table 4 for aggregate data). SPSS was used to conduct paired-sample t-tests. Cohen's d and common language (CL) effect sizes were also calculated for each. A Cohen's d effect size of .2 is interpreted as a small, .5 as medium, and .8 as large. We handled missing data using mean imputation.

Research Questions 2 and 3

In order to understand parents' perceptions of program involvement, we used participant interviews during Session 6 to gather qualitative feedback on the ways the academy was beneficial. Additionally, we wanted to understand to what extent the Pre–KPLA supports parents as leaders through school partnership teams. Upon conclusion of each of the six sessions, Pre–KPLA parent participants responded to two questions: (1) How did today's session contribute to my leadership development as a parent leader in school? and (2) What was most beneficial about today's session? Thematic analysis was used to analyze the narrative responses for each question (Strauss & Corbin, 1998). An analysis of each narrative response was conducted, and conceptual labels of thematic contents that emerged from the data were recorded. The first and second authors independently coded the narrative responses using the labels. Trustworthiness and cred-

ibility were established through member checking and searching for discrepant and negative cases (Goetz & LeCompte, 1984). Any discrepancies were resolved following coding comparisons by consulting the narrative responses for further clarification until a consensus was reached.

Results

Research Question 1

Paired-sample t-test analyses showed that Pre–KPLA participants significantly increased their self-reported school leadership behaviors and self-efficacy (see Table 4 for overall t-test results and Table 3 for item t-test results). Effect size of the program on leadership behaviors (d = 1.08) and self-efficacy (d = .79) was large. The CL effect size for school leadership behavior was .86, and for school leadership self-efficacy .79, indicating that the likelihood an individual will score higher on the posttest is 86% and 79%, respectively.

Research Question 2

Pre–KPLA parents provided narrative responses to the question "What was most beneficial about today's session?" Three main themes emerged: (1) improving kindergarten readiness, (2) health and character development speakers, and (3) hearing and learning from others.

Improving Kindergarten Readiness

The Pre–KPLA sessions provided parents with a better understanding of kindergarten and steps needed to prepare and support their child. One parent said, "I think I'm more prepared to get my son ready for kindergarten." Another parent stated that the sessions provided "good information on what to expect in kindergarten." To provide parents with these experiences, speakers from the school districts presented and led sessions on how to help students succeed.

Table 3. Pre–KPLA Pre–Post Individual Item Survey Results				
	Presurvey mean (SD)	Postsurvey mean (SD)	Cohen's *d* effect size	CL effect size
School Leadership Behaviors Individual Items (Range 1–6)				
I get other parents involved in projects I'd like to implement at my child's school.	4.33 (.89)	4.88 (.61)**	.51	.70
I talk with other parents about being involved in my child's school.	4.48 (1.00)	5.29 (.55)***	.74	.77
I talk with the principal at my child's school about school issues and/or projects that could be implemented in my child's school.	3.52 (1.31)	3.94 (1.20)*	.36	.64
I talk with my school's PTA/PTO committee members about school issues and/or projects that could be implemented in my child's school.	2.86 (1.06)	4.00 (1.08)***	.86	.80
I talk with my child's teacher and other staff about school issues and/or projects that could be implemented in my child's school.	4.00 (1.11)	4.88 (.56)***	.83	.80
I have been asked to take leadership roles at my child's school.	4.04 (.78)	4.31 (.59)	.26	.60
I have been asked to be involved in projects to improve student and school outcomes at my child's school.	3.76 (1.04)	4.69 (.78)***	.82	.79
School Leadership Self–Efficacy Individual Items (Range 1–6)				
I have the skills to be an effective parent leader in my child's school.	4.63 (.99)	5.53 (.45)***	.83	.80
I have the knowledge that it takes to be an effective parent leader in my child's school.	4.95 (.90)	5.47 (.52)*	.48	.68
I know how to get other parents and school staff involved in projects I'd like to implement at my child's school.	4.38 (1.03)	4.94 (.59)*	.48	.69
I can make a difference in my child's school.	4.95 (.82)	5.00 (.84)	.05	.52
I feel comfortable accessing community resources that can support my child's school.	4.45 (1.10)	4.94(.65)*	.39	.65
I feel comfortable contacting a member of the School Board of Education regarding my child's school.	5.19 (.87)	5.59 (.36)*	.44	.67
I feel comfortable participating in meetings with teachers about school-related issues.	5.57 (.54)	5.64 (.44)	.15	.56
I feel comfortable leading meetings with teachers about school-related issues.	4.71 (.99)	5.00 (.76)	.30	.62
I feel comfortable participating in meetings with other parents about school–related issues.	4.71 (.56)	5.35 (.67)**	.63	.73
I feel comfortable leading meetings with other parents about school–related issues.	4.57 (1.03)	4.82 (.77)	.25	.60
I plan to be involved in a specific school initiative to improve school climate and/or student academic success.	4.67 (.76)	5.29 (.55)**	.66	.75
Note: Paired-sample t-test analyses performed. *** *p* < .001. ** *p* < .01. * *p* < .05.				

Table 4. Pre–KPLA School Leadership Attitudes and Self–Efficacy *t*–Test Results									
	Mean pretest	SD pretest	Mean posttest	SD posttest	Mean difference	*t*–value	95% CI	*p* value	Cohen's *d* effect size	CL effect size
Leadership behaviors	27.00	4.44	32.00	3.67	5.00	6.10	3.33, 6.67	< .001	1.08	.86
Leadership self–efficacy	52.79	6.21	57.59	3.84	4.79	4.48	2.61, 6.98	< .001	.79	.79

Health and Character Development Speakers

Through the professional development sessions additional speakers and presentations provided information on mental and physical health, as well as children's character development. Parents recognized that these sessions provided the opportunity to be a better leader not only for their child at school, but also at home. One parent explained, "I learned how to contribute to my child's health at home and school [and] how to teach my child empathy, problem solving, and deal with emotions." Another parent described how this encouraged supportive parent–teacher communication: "1) Learning tools to use when working on bullying! Helping the victim; 2) Working with your teacher to form a team; 3) helping the bully work through their issues/trouble etc." Parent–child communication was also encouraged: "I really enjoyed the session regarding opening the doors of communication with my children, very helpful."

Hearing and Learning From Others

Each year the PTLA invites past participants back to share their school partnership team projects and lessons learned from involvement in the program. Additionally, the PTLA encourages the collaboration and networking of different school partnership teams. These connections provide a valuable opportunity for partnership teams to brainstorm and learn from each other. One parent said, "I enjoyed getting other ideas from everyone's project boards and sharing our board with others." Another parent shared benefits of networking with previous PTLA participants, namely, "seeing the ideas/task taken by members of other projects that would be beneficial to my child's school."

Research Question 3

Following each professional development section, Pre–KPLA parents answered the question "How did today's session contribute to my leadership development as a parent leader in school?" Thematic analysis revealed three categories: (1) inspired to take action, (2) new knowledge of school improvement goals, and (3) learning about additional school funding.

Inspired to Take Action

Depending on the focus of the session, many parents completed sessions feeling prepared to take action in their school or in their child's education. One parent explained that the session inspired her "to want to take more initiative and be involved with my kid's education." The sessions not only inspired parents to take personal action but promoted the importance of parent involvement in schools. One parent explained that the session "helped me see that parent involvement is an important part in the school," and another stated that the sessions taught her about more "opportunities to be involved in school."

New Knowledge of School Improvement Goals

School team partnership projects are created to meet the needs of a state–approved individualized school improvement goal. For many Pre–KPLA parents, these sessions provided an introduction to understanding these school improvement goals. One parent told how these sessions made the important connection between school improvement goals and partnership team projects: "The [school improvement goal] and the PTLA project must bring growth to school improvement." Another parent expanded and shared how learning about the school improvement goals led to "different ideas to help better with school involvement and learning."

Learning About Additional School Project Funding

The last theme to emerge in the third re-

search question revolved around grant writing, fund raising, and raising money to implement school improvement projects. Many parents were unaware of the extra funds available for their school and that it was possible to apply and seek out these funds. A parent explained that "understanding I can apply for grants or donations for my child's school" contributed to her leadership development as a parent leader. Another parent said they felt better prepared by "learning how to properly ask for a grant" and "preparing a [grant proposal] letter." Parents are encouraged to use these skills to further implement their partnership team projects and promote sustainability.

Discussion

Pre-K children can be better prepared for elementary school through established family–school programs (Sheridan et al., 2010). The Pre-KPLA promotes family–school partnerships with the University of Alabama acting as a community partner and key stakeholder. Young children are often faced with barriers associated with kindergarten and elementary school readiness such as poverty, low parental education, and parental mental health concerns (Snow et al., 1998; Zill & West, 2001). However, building capacity for parent–teacher relationships and effective parental involvement can minimize these barriers (Berryhill et al., 2019; Mapp & Kuttner, 2013). The current study analyzed the 2017–2018 and 2018–2019 cohort data of the University of Alabama's Pre-KPLA to build parent participants' school leadership behaviors and self-efficacy.

Pre- and posttest survey responses determined that parent participants significantly increased the scores on their self-assessment of school leadership behaviors between the first session and graduation. Seven individual leadership behavior items were included in the pre- and posttest survey. Consultation of individual leadership items indicates that three significant items—(1) "I talk with other parents about being involved in my child's school," (2) "I talk with my school's PTA/PTO committee members about school issues and/or projects that could be implemented in my child's school," and (3) "I talk with my child's teacher and other staff about school issues and/or projects that could be imple-

mented in my child's school"—might be attributed to opportunities provided during sessions to communicate and collaborate with peers and teachers. Another significant item, "I have been asked to be involved in projects to improve student and school outcomes at my child's school" could be looked at in direct relation to participation in Pre-KPLA. However, this item could include new or ongoing school projects in which parents are involved. Through the partnership team model, Pre-KPLA emphasizes effective parent–teacher teams through collaboration and relationship building. Sessions provide parents and teachers a space for guided meaningful conversations centered around student learning in their respective school. Pre- and posttest survey responses indicate that parents' leadership behaviors—specifically, having these conversations—increased between the first session and graduation. The high effect sizes of the survey, however, should be regarded with caution, as these sizes are based on 34 participants' responses.

Overall school leadership self-efficacy of parent participants also significantly increased from Session 1 to graduation as indicated by pre and post survey responses. Eleven individual school leadership self-efficacy items were included in the pre- and posttest survey. Consultation of individual leadership items indicates seven significant items. The item with the greatest mean change was "I have the skills to be an effective parent leader in my child's school." The Pre-KPLA not only provides parents and teachers with the skills to build a project with their partnership team during the time of the academy, but provides teams with the knowledge and skills to promote sustainable partnerships beyond the academy. Other significant items included (1) "I feel comfortable participating in meetings with other parents about school-related issues" and (2) "I plan to be involved in a specific school initiative to improve school climate and/or student academic success." After completing the academy, Pre-KPLA parents not only felt more comfortable meeting with other parents about school-related issues, but planned to continue to do so beyond the program. Supporting and building capacity for effective parent involvement and parent–teacher relationships can improve children's academic outcomes and achievements (Hornby, 2000, 2011; Jeynes, 2005).

Qualitative results suggest that the Pre-

KPLA supported parent–teacher partnerships by (1) inspiring parents to take action, (2) providing information about school improvement goals, and (3) teaching parents about additional school project funding. These results reinforced the parents' involvement in their child's education, while also supporting parent–teacher partnerships. Past research suggests that children are more likely to achieve enhanced academic performance and social skills when their parents are involved in the child's education and school (El Nokali et al., 2010; Pomerantz et al., 2007). The Pre-KPLA utilized purposeful implementation within its sessions to promote meaningful content, partnership team collaboration, and, additionally, team project application. These steps enabled parent participants to expand their belief in their ability to effect change at their school through leadership. Qualitative themes support pre and post survey results, indicating that parents increased leadership behaviors and self-efficacy through the six sessions.

Next Steps and Conclusions

Limitations within the study contribute to the program's next steps, improvement, and growth. Additionally, collaboration between partners, facilitators, and participants led to the following recommendations for the program. The study limitations and their impact on the program moving forward will be discussed. First, not all Pre-KPLA graduates completed the pre- and posttest surveys. Lack of participation in program surveys ultimately stemmed from a barrier surrounding attendance. In an effort to improve attendance and further retention, all academies within the PTLA will be transitioning to a 2-year mentor model. The 2-year mentor model provides parents and teachers with the opportunity to serve on their school team for two consecutive years. Each year, one new parent and one new teacher will rotate onto the school team. The transition to this model provides 2nd-year participants to serve as mentors and leaders for first-year participants. Additionally, this model will alleviate some of the stress that principals and administration are subject to while choosing and nominating participants. Parents and teachers who are eager to participate are invited back to continue to build upon their partnership project.

Second, although the composite mean scores of the parent leadership self-efficacy were significantly different, not all individual items were significant. For example, the following items saw a difference in pre and post mean test scores but not a significant difference: (1) "I can make a difference in my child's school" and (2) "I feel comfortable participating in meetings with teachers about school-related issues." Future research should further investigate the possible barriers to these items and how to build stronger parent–teacher relationships. The initiation of the 2-year mentorship model will allow us to further explore these limitations as Pre-KPLA parents return to the academy as kindergarten EPLA parents and mentor new Pre-KPLA parents.

Third, future research should use follow-up assessments to further investigate whether leadership behaviors and self-efficacy persist over time following completion of the Pre-KPLA. Additional knowledge can be gained by also factoring in the impact of attendance on sustainable behaviors, which will require the implementation of a clear attendance policy in addition to the 2-year mentor model. The attendance policy will figure into requirements for academy graduation and eligibility for academy partnership project grants. Further, taking into account the world's transition to virtual and remote learning, all academies will offer virtual and hybrid sessions. Offering these virtual and hybrid sessions will provide parents and teachers with more flexibility and options to attend.

Fourth, the pre- and posttests for leadership behaviors and self-efficacy are unvalidated instruments for measuring these constructs. Furthermore, these self-reported questionnaires do not measure the effect of the Pre-KPLA on actual leadership behaviors and self-efficacy. Future research should focus on utilizing a validated and reliable measurement tool.

Other limitations included the homogeneity of parent participants, with all participants being female. Homogeneous sampling limits the applicability of results to dissimilar populations.

The purpose of this article is to provide data on the Pre-KPLA, specifically to what effect and how the development program equips Pre-K school parents to increase engagement and form school partnership teams. Significant results indicate that the Pre-KPLA increased parent leadership behaviors and self-efficacy. As demonstrated through

past research, family engagement and parent–teacher relationships are a necessary component of student success, and also figure in elementary readiness for young children. The Pre-KPLA provides opportunities for parents and teachers to develop successful parent–teacher relationships and increase parent involvement. The creation and implementation of school partnership teams additionally strengthens these relationships and increases the number of opportunities for teams to support their school. Pre-KPLA's goal is for these collaborations to foster additional parental school involvement, build parent–teacher relationships, and, ultimately, enhance elementary student readiness and outcomes.

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Testing Impacts of Goal-Oriented Outreach With the Girl Scouts: Can a Single Activity Change Attitudes Toward Insects?

Andrew J. Mongue and Kaila L. Colyott

Abstract

Most people meet insects with fear and disgust, even though few insects pose health risks; in fact, many are beneficial and their absence would adversely affect human life. Such misunderstandings lead to insect conservation being important but unpopular. We addressed these concerns as part of a broader effort to establish an ongoing outreach partnership between graduate students at the University of Kansas and the Girl Scouts of Northeast Kansas/Northwest Missouri. To explore ways to advocate for insect conservation, we held an insect-collecting activity at a Girl Scout summer camp and surveyed changes in attitudes toward insects. This activity positively changed reactions to insect encounters and increased confidence in identifying harmful insects but did not strongly reduce fears or increase curiosity toward insects. Beyond these proximate results, this project highlights the potential of Girl Scout troops as targets for informal science education that can benefit both academics and the broader community.

Keywords: university–community partnership, sustained collaboration, women in science, entomology

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Insects are among the most abundant and diverse groups of organisms, accounting for over half of modern animal life on the planet (Foottit & Adler, 2009). Because of this, humans have encountered insects perhaps more than any other animal (Robinson, 1996), as shown by ancient insect remains among prehistoric settlements (Overgaard Nielsen et al., 2000; Panagiotakopulu, 2003). Further, even though we may think that modern ways of life have separated us from natural ecosystems, many insects are very successful in urban environments. Unlike larger animals that need substantial tracts of undisturbed habitats, insects can thrive in small, fragmented urban environments (e.g., parks and lawns). And unlike other urban species that are associated with low-income areas (e.g., mice; Cohn et al., 2004), insect diversity actually increases in affluent areas (Leong et al., 2016), making them a ubiquitous sight in and around homes in all communities.

In spite of, or more likely because of, this familiarity, insects are profoundly unpopular with the general public in the United States. One study found less than 10% of people enjoy insect encounters in nature, and even fewer (<1%) enjoy encountering insects in their home (Byrne et al., 1984). Another survey found that over 85% of people dislike or are afraid of arthropods (the animal phylum including insects, spiders, and crustaceans) found in the house (Hahn & Ascerno, 1991). Some of this fear and disgust may be justified in the case of disease-vector species, including mosquitoes (Beerntsen et al., 2000; Ledesma & Harrington, 2011) and kissing bugs (Prata, 2001). Researchers have in fact proposed that the disgust that is so often generalized to all insects is an evolutionary behavioral adaptation to avoid the parasitic or disease-spreading species (Curtis et al., 2004).

Although the instinct to fear and be repulsed by insects may have served our species well

historically, it is also demonstrably an over-reaction to most commonly encountered insects, the vast majority of which pose no threat to humans. A survey of biodiversity of arthropods in North Carolina households showed that most species encountered in the American home are benign (Bertone et al., 2016). For instance, only a small minority (~10%) of mosquito species are known disease transmitters (Rueda, 2008); in other words, disease vectoring is less common than one might imagine among insects that feed on humans. In fact, in other cultures, the opposite relationship exists: Some insects are seen as suitable human food. People in Japan (Mitsuhashi, 1997), Australia (Conway, 1991), and even some Native American tribes (Navarro et al., 2010), to name but a few, have histori-cally eaten insects as a regular part of their diet; indeed, some continue to do so. Food scientists are beginning to recognize the potential of insects as a way to provide more sustainable nutrition to growing global populations (Gahukar, 2011; Van Huis, 2013). But among Europeans (Hartmann & Siegrist, 2017) and Americans (Ruby et al., 2015), there is a strong cultural disgust with the idea of eating insects, especially in an unprocessed form. Both this disgust and the generalized dislike of insects are unfounded and ignore the many beneficial services insects provide.

A Case for Insects

Setting aside the potential for insects as human food, nonpest insects play vital roles in ecosystem health and stability, most commonly by breaking down organic matter and facilitating nutrient cycling (Samways, 1994). In forests, for instance, presence of insect herbivores significantly increases available nutrients like nitrogen and phosphorus in the soil (Chapman et al., 2003), and up to 20% of wood degradation can be attributed to insects like termites and wood-boring beetles (Ulyshen, 2016). Even in human-made ecosystems, insects fill human-benefiting niches in waste de-composition, like the removal of dung from livestock pastures (Jones & Snyder, 2018), which helps promote grass growth and reduce habitat for insects that parasitize livestock (Fincher, 1981; Gillard, 1967). Even more important for the limiting of disease spread, many insects assist in the decom-position of carcasses (Matuszewski et al., 2008), a fact that also provides clues to fo-rensic analysts in criminal cases (Buckland, 1988; Byrd, 2002).

Finally, and most popularly known, insects also pollinate many plants, including agri-cultural crops. The majority of crops are at least partially insect-dependent for pollina-tion and fruit production, and crops like al-monds, hay, and blueberries are completely dependent on insect pollinators (Morse & Calderone, 2000). The economic value of bee pollination alone in the United States provides services worth upwards of $5 bil-lion (Southwick & Southwick, 1992). Add to this the other benefits, including those described above, and the total value of all insect services to society is estimated at $57 billion in the United States alone (Losey & Vaughn, 2006). Thus, the overwhelming fear and dislike of insects and their relatives is not only unfounded but also problematic from an economic point of view.

Generating Public Support

For all of the above reasons, there is a great need to promote acceptance and conserva-tion of insects, but little has been done to advocate for this group of animals. Most conservation efforts focus on charismatic species, typically large mammals (e.g., whales; Scott & Parsons, 2005). Only a few well-known insects, most prominently the monarch butterfly, have received compa-rable attention (Diffendorfer et al., 2014; Missrie & Nelson, 2005; Oberhauser & Solensky, 2004). Given the scale of insect diversity, rather than attempting to gen-erate case-by-case popularity, a greater ecosystem-level and, indeed, human ben-efit could be obtained with conservation of the broader group of arthropods, focusing on their positive contribution as members of an ecological community (Hughes et al., 2000; Panzer & Schwartz, 1998; Samways, 2007). Before tackling more comprehensive conservation efforts, however, public atti-tudes toward insects must be improved to ensure the success of those efforts. In this study, we sought to quantify the efficacy of single-intervention teaching in changing attitudes and reactions toward insects.

Reaction to insects, especially in the West, is a gendered response. The abovementioned study of American reactions to eating in-sects found women less willing to consider insects as food than men were (Ruby et al., 2015). More generally, both adult women and girls have stronger negative reactions to insects and associated invertebrates

(especially spiders; Borgi & Cirulli, 2015; Cornelius & Averill, 1983). Some research suggests that yong girls are more inclined to generalize learned fear cues for invertebrates than boys are (Rakison, 2009), but both this research and the observation that both gender and cultural attitudes vary around the world suggest that these fears are learned. Thus in our attempt to change attitudes toward insects, we focused on a demographic with perhaps the worst perceptions of insects: grade–school–aged children socialized as girls.

Outreach Partnership With the Girl Scouts

Our efforts to change insect popularity grew from a broad partnership with the Girl Scouts of Northeast Kansas and Northwest Missouri. After initial successful volunteer events with local troops, we were approached by Girl Scout program managers to expand involvement and increase outreach teaching opportunities for graduate students at the University of Kansas. With a formal community partnership, graduate students designed five single–activity modules based on both their research interests and relevance to teaching objectives for Girl Scout badges. These activities were hosted on the Girl Scouts' community partner webpage, and troop leaders could then contact these graduate students to schedule an activity for their troop. This arrangement benefited both parties, as troop leaders could select the most relevant activity for the needs or interests of their Girl Scouts, and graduate students offered activities most directly relevant to their own interests and expertise. Over the course of 2 years, these programs have reached roughly 500 Girl Scouts and resulted in our programs receiving a 2018 Community Collaboration Award.

For a specific example, we, the authors, began by offering an activity to help Brownie Scouts meet requirements to earn their Bugs Badge. The badge has multiple components, ranging from insect–themed arts and crafts to exploration of insect habitats. We focused on the latter, showing Girl Scouts where and how to collect local insects. This activity was one of the more popular, being requested by 166 Girl Scouts in total. Owing to the qualitative change in attitudes we noticed in Girl Scouts who participated in these activities in the first year of our partnership, we designed a simple survey to test whether a single activity interacting with arthropods could reduce fear and increase appreciation of local insect species.

We obtained Institutional Review Board approval for study design and consent language from the University of Kansas (IRB ID: 00141007) and carried out the survey at a Girl Scout summer camp in summer 2017. We informed the parent or guardian of each participating child upon their arrival at camp that their child was in a camp group connected to a research study. We gave the parent or guardian a verbal summary of the project and a paper copy of the survey to review before asking them to sign a consent form allowing their child to participate in the study. Parents had the option of opting out of the study by not signing the consent form, without affecting their child's ability to participate in camp activities, including insect collection. Children without parental or guardian consent were not given a survey to complete, and no identifying information was collected for any child during the survey process.

We administered the survey to groups of Junior and Cadette rank Girl Scouts for 2 months in summer 2017 at Camp Daisy Hindman, in rural Dover, Kansas (n = 88 total respondents). To minimize identifiable information collected, we did not record ages of participants, but these ranks correspond to fourth to eighth grade students. To be clear, we did not ask, nor do we make proscriptive assumptions about the gender of any individual scout in our study, but the Girl Scouts as a group is surely enriched for individuals socialized as girls. Throughout the summer camp season (June–July), we visited the camp each week and collected data from two groups of Girl Scouts. Each week, one group worked with us on an insect–collecting activity before taking a survey of attitudes and reactions toward insects. The second (control) group had no interaction with us prior to the survey. Collecting activities varied by week (black–light trapping, stream collecting, or open field sweep netting) depending on the camp program and weather, but in each activity Girl Scouts collected insects and transferred them from a net to a mesh cage by hand. Throughout the activity, we encouraged Girl Scouts to share their discoveries and help each other with collecting. With the Girl Scouts' consent, we saved representative specimens of collected species to be pinned and spread by us as part of a display kept at the camp.

For each activity, we used a teaching collection of pinned insects to facilitate a short discussion (~10 minutes) that included an overview of stinging insects and an open-ended question and answer session. Immediately after the hands-on collecting session, we spent a short time (~5 minutes) asking Girl Scouts to share their favorite catches. The Girl Scouts for whom we had obtained prior parental consent were then given a survey to fill out. For the control group, Girl Scouts were given surveys immediately after completing their regularly scheduled camp activities (e.g., tie-dying or horseback riding) with no collecting activity or discussion of insects. Camp groups that were chosen as control groups were selected to keep the number of participants and ages roughly equal between the treatment and control.

Survey Content and Analysis

The anonymous surveys consisted of 15 questions, with three background questions and 12 retrospective before/after questions that asked participants to answer how they felt both before and after their time at the summer camp (full survey shown in Table 1). The use of a retrospective pretest–posttest design (i.e., administering both the pre- and posttest questions after the intervention) provides a more accurate assessment of change than a conventional pretest–posttest design (i.e., administering pretest before and posttest after) because it enables the respondent to use a consistent scale when answering questions about both the present and past (Nakonezny & Rodgers, 2005). Additionally, scheduling a single block of time for survey completion minimized the disruption to the children's other camp activities and facilitated scheduling with the counselors.

Most questions were based on a Likert-like scale of responses (e.g., *always, often, sometimes, never*), but the reactions to the encounter questions were subjectively ranked from least desirable to most: killing the insect or spider (fearful and destructive), running away (fearful and passive), ignoring it (neutral/nondestructive), moving it outside (active and unafraid). Background questions were implemented as a check to ensure no systematic differences existed in everyday exposure to arthropods between our treatment and control groups. The 12 retrospective before/after questions were also designed in pairs for control: One set asked about attitudes toward insects ("bugs" in the survey) and the other asked about spiders, which were not a part of the hands-on teaching or open-ended discussion, but are often cited in popular culture and scientific literature as an invertebrate that women fear more than men do. The spider questions thus created an additional check that time spent at camp was not changing attitudes about invertebrates in general by virtue of bringing campers closer to nature than they would be at home.

Prior to downstream analyses, we curated the data for irregularities. A small minority of Girl Scouts skipped questions, chose multiple answers to a single question, or answered in a manner seemingly contrary to the design of the experiment (i.e., individuals from the control group indicating that they worked with us, despite no interaction at camp prior to the survey). This last class of problems was rare but potentially confounding, as we had been doing community outreach workshops for the 2 preceding years in the area, so some Girl Scouts in our control groups may have had previous experience with our teaching outside the scope of this project. To be conservative in analyses, we discarded both of the surveys that had the uncertain treatment status described above; this curation brought our sample size down from 88 to 86 (45 treatment, 41 control). For the remaining irregularities, answers were excluded on a case-by-case basis (e.g., a Girl Scout who skipped or gave multiple answers to Question 3 would still have their answers to Questions 4–15 included in analyses), resulting in slight differences in sample sizes between questions. We coded each potential response to a question as a number from 0 to 3 for analysis. Although these data are not continuous and not necessarily normally distributed, parametric tests should be robust to these assumptions, given our sample sizes surveyed. Thus we assessed simple differences in the treatment and control groups with t-tests for the background questions.

For the focal questions, however, we needed to consider the compound effects of both our direct intervention and the Girl Scouts' broader camp experiences changing attitudes on their own; this design defies a simple t-test approach. To parse the more complicated effect of our lessons while controlling for time at camp, we analyzed results in a permutation framework that

Table 1. Survey Questions Presented to Girl Scouts				
1. Did you spend time working with the bug people at camp?	YES	NO		
2. How often do you encounter bugs at home?	Always	Often	Sometimes	Never
3. How often do you encounter spiders at home?	Always	Often	Sometimes	Never
4. How afraid were you when encountering bugs at home BEFORE coming to camp?	Very afraid	Somewhat	Not very	Not afraid
5. How afraid were you when encountering spiders at home BEFORE coming to camp?	Very afraid	Somewhat	Not very	Not afraid
6. BEFORE coming to camp, when you encountered a bug at home, what would you do?	Kill it	Run away	Ignore it	Move it outside
7. BEFORE coming to camp, when you encountered a spider at home, what would you do?	Kill it	Run away	Ignore it	Move it outside
8. How likely were you to pick up a bug and be curious about it at home, BEFORE coming to camp?	Always	Often	Sometimes	Never
9. How good do you think you were at determining if a bug was dangerous or not, BEFORE coming to camp?	Great	Good	OK	Not good
10. How afraid are you of encountering bugs at home AFTER coming to camp?	Very afraid	Somewhat	Not very	Not afraid
11. How afraid are you of encountering spiders at home AFTER coming to camp?	Very afraid	Somewhat	Not very	Not afraid
12. AFTER coming to camp, when you encountered a bug at home, what will you do?	Kill it	Run away	Ignore it	Move it outside
13. AFTER coming to camp, when you encountered a spider at home, what will you do?	Kill it	Run away	Ignore it	Move it outside
14. How often do you think you will pick up a bug and be curious about it, AFTER coming to camp?	Always	Often	Sometimes	Never
15. How good do you think you are at determining if a bug is dangerous or not, AFTER coming to camp?	Great	Good	OK	Not good

Note. Participants were asked to circle an answer to each question either after the insect activity (treatment) or immediately upon gathering after a non‑insect‑related activity (controls).

made no assumptions about underlying data distributions. First we calculated the difference in means before and after time at camp in the treatment and control groups separately. Then we calculated the difference of these differences to get a measure of how dissimilar the treatment and control groups were while controlling for general experiences at camp. To assess significance of these differences, we then carried out permutations randomly assigning Girl Scouts to treatment or control groups of sizes equal to the true groups. As before, we calculated the difference of differences between our pseudotreatment and pseudocontrol groups. By repeating this for 1,000 permutations, we generated an expectation of differences between groups that could occur by chance. We then compared our true value to this distribution; the *p*‑value was taken as the proportion of times that the true difference was more extreme than the randomly gen‑

erated differences. Consequently, there are no test statistics per se to report for these analyses, only *p*-values. Questions with significant shifts in attitude are shown in the figures that follow, with counts for each answer in both treatment and control groups. All analyses and data visualizations were carried out using custom scripts written in R version 3.4.1.

Findings

The control and treatment groups did not differ in exposure to insects at home (Question 2; $t_{78.1}$ = 0.19, *p* = 0.85), but, oddly, they reported a difference in spider encounters, with the control group encountering fewer spiders (Question 3; $t_{80.5}$ = 2.41, *p* = 0.02). This starting difference is less relevant for our focus on insects, and moreover appears to have no biasing effect, as groups did not differ from each other in their reaction to (*p* = 0.555, Questions 7 & 13) or fear of (*p* = 0.293, Questions 5 & 11) spiders while controlling for time at camp.

With regard to insects, two of our metrics showed significant changes in our treatment group after the activity. Girl Scouts became more confident in being able to identify dangerous insects (*p* = 0.018, Questions 9 & 15) and became less likely to kill or run away from an insect encountered at home (*p* = 0.041, Questions 6 & 12). Results with sample sizes can be seen in Figure 1A and Figure 1B respectively. Our two other metrics, curiosity (Questions 8 & 14) and fear of insects (Questions 4 & 10) did not significantly change after our lesson, but did trend in the direction of more curiosity (*p* = 0.099) and less fear (*p* = 0.180). In the latter case, both treatment and control groups reported marginal decreases in fear after their time at camp. These results, including sample sizes, are summarized in Figure 2A and Figure 2B.

Discussion

The public in general dislikes insects more than most animals (Byrne et al., 1984), and women more than men find them disgusting (Curtis et al., 2004). In a targeted effort to change these attitudes, we designed a set of activities to carry out with the Girl Scouts of Camp Daisy Hindman. Afterward, we surveyed Girl Scouts to assess how effective activities involving live insects can be in changing perceptions. In brief, we found that we increased confidence in differenti-

ating dangerous and harmless insects and positively changed self-reported reactions to an insect encounter. Girl Scouts became less likely to kill insects encountered in the home and more likely to move them outside or ignore them. Both of these results are encouraging for the goal of increasing acceptance of insects. Decreasing instances of immediately killing an insect found in the home can only help conserve insects, and learning to confidently differentiate dangerous and harmless insects should lead to fewer perceived threats from encounters with harmless insects. Whether or not this effect persists in the long term would be an obvious target for future study.

On the other hand, we failed to strongly increase curiosity or decrease fear of insects in the span of this activity. However, both of these metrics showed small changes in the desired direction after our lesson, so it is possible that this hands-on approach could be effective but would require more engagement time to generate strong changes. As with the positive results, it would also be fruitful to examine the fear and curiosity components after repeated interactions.

Another possibility is that we failed to identify fears in a precise enough way to notice a change. Girl Scouts who participated in our activity reported becoming more confident in identifying dangerous insects but did not report a decrease in fear of "bugs" as a blanket category. Considering these two outcomes together, it would be interesting to ask about fears of specific groups of insects to see if fears become less generalized and more concentrated on groups that can cause harm, like ants and wasps. We avoided such detailed questions in this initial survey out of a desire to keep the survey portion short and easy to complete, but it would be appropriate for a more targeted follow-up study.

More generally, our activity sparked engagement in spite of using an unpopular group of animals, suggesting a great potential to stimulate excitement with this age group. The surveyed scouts were late elementary school to middle school aged, the time when girls become less likely than boys to pursue interests in sciences (Blickenstaff, 2005); similarly, hands-on approaches with Girl Scouts make an obvious target for promoting women in STEM (science, technology, engineering, and math). Finally, we recognize that our work as well as the work cited here is limited to

A   **How good do you think you were at determining if a bug is dangerous?**

B   **When you encounter a bug at home, what would you do?**
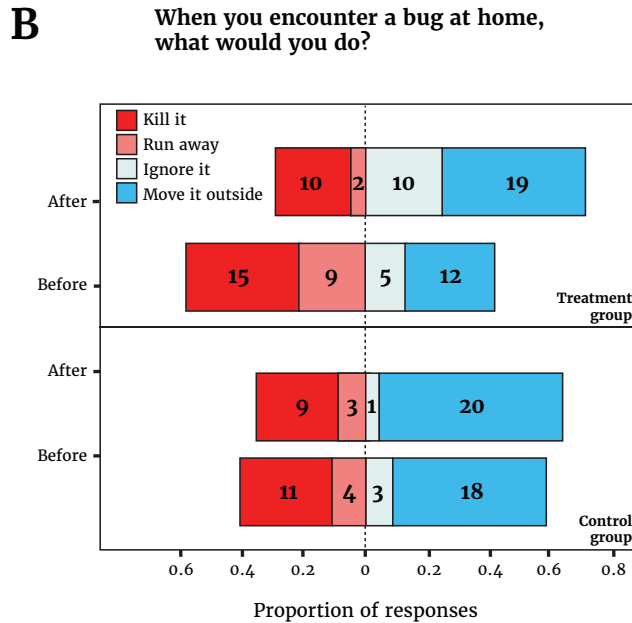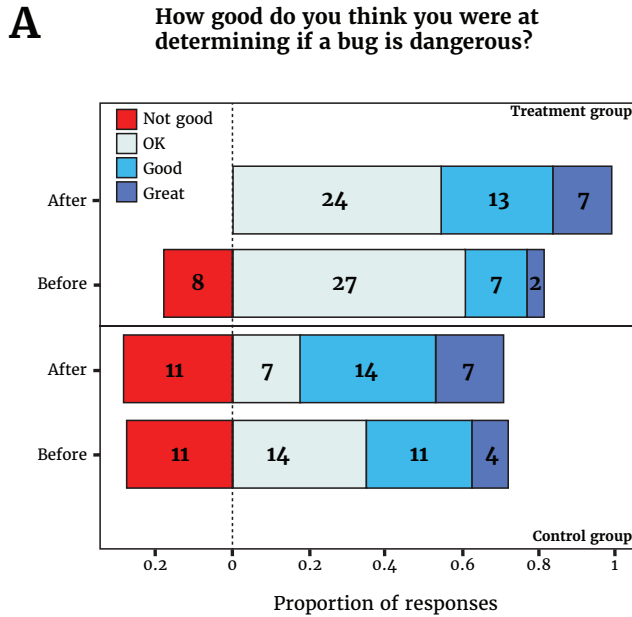
Figure 1A and 1B. Metrics Showing Significant Change in Treatment Group

Note. 1A. Girl Scouts who participated in the insect–catching activity became more confident (*p* = 0.018) in identifying dangerous insects (top panel) than their control counterparts (bottom panel). 1B. Likewise, Girl Scouts from the treatment group became more likely to move an insect outside and less likely to kill it or run away (*p* = 0.041) after the lesson. Each response category is color coded per the legend, and numbers in each category represent counts of respondents.

A   **How likely were you to
pick up a bug and be curious?**

B   **How afraid are you of
encountering bugs at home?**

Figure 2A and 2B. Metrics Showing Lack of Significant Change in Treatment Group

Note. 2A. The difference in curiosity and willingness to pick up insects for both treatment and control groups after treatment was not significant ($p = 0.099$) but trended toward an increase in curiosity, as can be seen in the top panel. 2B. Our activity did not decrease respondents' fears of insects ($p = 0.180$) in any meaningful way. As with the other figure, each response category is color coded per the legend, and numbers in each category represent counts of respondents.

binary gender categories (i.e., women and men, girls and boys). We suggest that future research would benefit from being more gender inclusive (i.e., nonbinary and other minority gender individuals) in surveying, especially given that these groups have been historically overlooked when promoting inclusion in STEM.

Lessons Learned: Graduate Student–Girl Scouts Partnership as a Mutually Beneficial Relationship

We found that our regional Girl Scout organization offers a receptive audience for informal STEM education, and we suggest that they make an excellent venue for outreach across the sciences. By advertising our STEM expertise and taking requests for outreach teaching, we were able to match our science skillset with a demand in the community. This two-way interaction sparked our initial interest in formally assessing the effectiveness of our outreach activities, and we submit that this approach can serve as a useful model for goal-oriented outreach among academic researchers.

Although such outreach may be more common among other educational groups, for many research-focused scientists, outreach remains an unorganized endeavor. Developing broad community impacts is an important component of many academic positions, but it often receives less attention than research or formal (i.e., classroom-based) teaching. We submit that outreach can and should be approached in the same manner as the rest of the scientific process: with concrete objectives 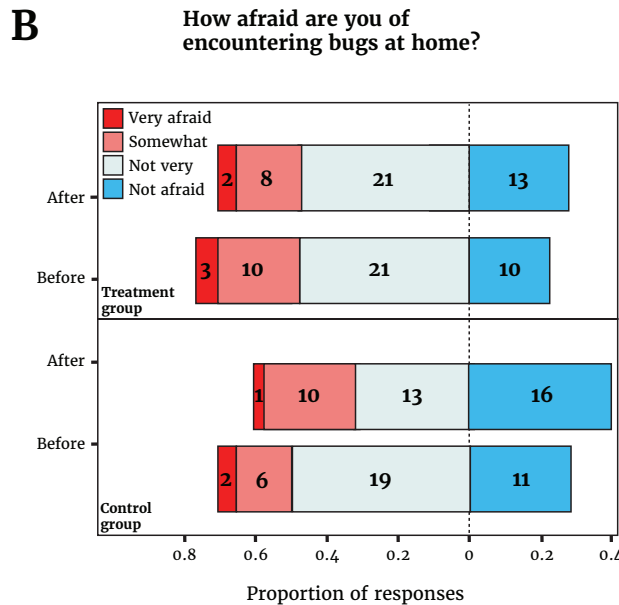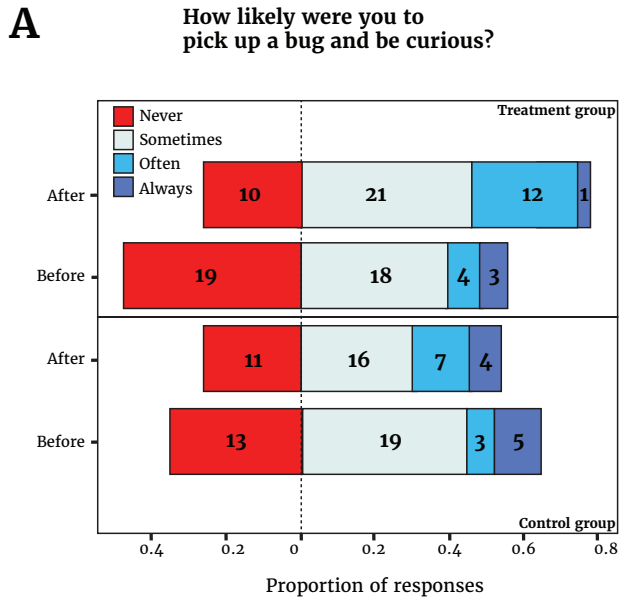and empirical validation to assess how successfully these objectives are met. Under this paradigm, outreach events are more beneficial to both the researchers and the public. Researchers can have meaningful interactions and encourage interest in science, as we saw with scouts' confidence in insect identification and decreased inclination to kill insects in this study.

Next Steps

The established structure and persistent groups of Girl Scout troops make excellent partners for repeated scientific engagement across multiple years. Anecdotally, we have seen some of the same children at multiple outreach events, but, due to our limited time in graduate school, we are not able to formally track the longer term impacts of our activities on either interest in science or attitudes toward insects. Although we, the authors, have since graduated, we are happy to report that the Girl Scout partnership still exists with current graduate students at the University of Kansas and continues to offer a platform for informal STEM teaching. In its current incarnation, the partnership consists of the continued independent modules as well as an annual STEM activity day at one of the camps (Camp Tongawood); current graduate students have plans to use this venue for outreach outcome surveying.

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Sight and Sole: Partnering to Enhance the Health of the New Britain Homeless

Stacy Christensen and Michele McKelvey

Abstract

Nursing faculty with expertise in community health are well poised to introduce nursing students to the rewarding experience of caring for vulnerable populations. Multiple partnerships have been established over the years within the central Connecticut region that have benefited both the university's nursing students and the affiliated agency, as well as the individuals served. Utilizing knowledge related to the common health issues faced by the homeless population, faculty worked with community partners to discuss needs and create a plan involving nursing students, which specifically focused on vision and foot health.

Keywords: homeless, vision health, foot health, nursing, community partnerships

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Central Connecticut State University (CCSU) is a public university located in New Britain, Connecticut. The university enrolls about 12,000 students and is richly diverse, with more than 30% of students being persons of color. The university offers 100 majors at the undergraduate level and approximately 40 fields of study at the graduate level. CCSU boasts four elements of distinction: international education, workforce and state economic development, interdisciplinary studies and cross-curricular initiatives, and community engagement (CCSU, 2019a). Recognizing the current widespread importance of community connections and academia, CCSU has established an Office of Community Engagement. This office "seeks to engage the CCSU campus community in projects and outreach that are mutually beneficial, contribute to the greater good, and build a sense of civic responsibility" (CCSU, 2019b, para. 1). The mayor of the city has enthusiastically recognized the university's commitment to community engagement, working closely with the president of the university to build and sustain a strong partnership.

New Britain is a city with a proud history and rich in diversity, having a population of approximately 72,000 with a high percentage (43.3%) of Hispanics. Approximately 21.7% of the residents live below the poverty level (United States Census Bureau, 2019). Like many cities, New Britain struggles with homelessness. Although the number of individuals experiencing homelessness in New Britain is hard to accurately determine, a point in time count held in January 2018 by the Connecticut Coalition to End Homelessness indicated that there were 161 of these individuals in the city (Connecticut Coalition to End Homelessness, 2018). The city of New Britain has recently renewed its long-time commitment to end homelessness through the Building Hope Together initiative. The work in this area concentrates on three goals. One of the three goals recognizes the importance of wellness in this complex equation, specifically focusing on "assessing individual need, providing access to care, and linking community partners."(City of New Britain, 2018, slide 5). CCSU's Office of Community Engagement is an identified community partner in this aggressive work plan (City of New Britain, 2018).

The homeless population remains one of the most vulnerable groups in society. Adults experiencing homelessness generally have more compromised physical and mental health and a shorter life span than the general public (Taylor et al., 2016).

Health disparities in these individuals are well documented in the literature. People without homes are particularly at risk for the following conditions: diabetes, hepatitis, asthma, substance abuse, depression (Taylor et al., 2016), chronic pain, food insecurity (Moore et al., 2019), and intimate partner violence (Vijayaraghavan et al., 2012). Individuals experiencing homelessness most commonly self-report headaches, hypertension, arthritis, back pain, neurological disorders, and hypercholesterolemia (Arnold et al., 2020).

Individuals experiencing homelessness frequently take multiple medications for multiple illnesses, particularly antihypertensives and diabetic medications. Unfortunately, lack of health insurance is associated with poor management of illness in this population (Asgary et al., 2016). Many medical conditions common to this group require specialty care, which is often inaccessible, and inability to pay is very often a barrier to care among those who are homeless (Arnold, et al., 2020). Healthcare for those experiencing homelessness is commonly obtained in hospital emergency departments. At times, medications and treatments may be stolen or traded for drugs, food, or cash (Hauff & Secor-Turner, 2014).

A large national study on health needs of this population revealed that 73% of adults experiencing homelessness recounted one or more unmet health needs, and 32% were not able to receive necessary medical or surgical treatment (Baggett, O'Connell, Singer, & Rigotti, 2010). Homelessness is a prolonged experience for many. With increased duration of this situation, individuals have less access to healthcare and subsequently a lack of access to necessary medications (Paudyal et al., 2017). Complex comorbidities and lack of access to healthcare accounted for high mortality rates and health disparities among this population (Plumb, 2000).

Although the literature on homelessness is extensive, the ocular health of individuals experiencing homelessness remains undetermined. Noel et al. (2015) examined the unmet eye care needs in this population and found that, of those participating in screening, approximately one third had one or more visual abnormalities. Since visual acuity is strongly correlated with well-being and earning potential, identification and correction of compromised vision can have significant socioeconomic benefits for those experiencing homelessness. These individuals indeed desire visual screening (Noel et al., 2015). Providing this screening along with filled prescriptions for glasses can enhance the well-being and overall quality of life in this particular population.

In addition to ocular health, "compared to housed individuals across studies, homeless individuals were more likely to have foot problems including: tinea pedis, foot pain, functional limitations with walking and improperly fitting shoes" (To et al., 2016, para. 3). Up to two thirds of people experiencing homelessness report concerns with their feet. Although foot problems in this population have been well documented, these health issues are commonly overlooked and treated inadequately. Poor hygiene, lack of access to clean and well-fitting socks and shoes, as well as inadequate financial resources, contribute to foot problems (Chen et al., 2012). Walking is the most common mode of transportation for individuals without a home and, therefore, immobility can have a significant impact on lifestyle and well-being. Given the significant impact of foot problems, screening for and treating foot problems in those who are homeless could result in better overall health and improved social outcomes.

In an attempt to conform to a university priority of being a more effective steward of central Connecticut, in fall 2017 the university Faculty Senate Community Engagement Committee announced a grant opportunity to further support community-focused initiatives. A request for proposals was created, open to all academic departments. Proposals were reviewed and funding was awarded in spring 2018. Two faculty members from the Department of Nursing were awarded a $2,500 grant. The grant, titled "Sight to Sole; Partnering to Enhance the Health of the New Britain Homeless," sought to engage nursing students with individuals experiencing homelessness in the New Britain area to positively impact the health of this local population, with a specific focus on vision and foot care. The project included four primary goals:

1. Improving the health of the homeless population in New Britain by providing interventions which enhance vision and foot health of homeless individuals.

2. Providing opportunities for students to engage in service-learning activi-

ties that include critical reflection and potential for personal growth.

3. Enhancing student understanding of social determinants of health so that they may be better able to advocate to eliminate health disparities.

4. Exemplifying the commitment to community engagement as defined by the Carnegie Foundation plan by fostering relationships with several community partners.

Overview of the Project

Nursing faculty with expertise in community health are well poised to introduce nursing students to the rewarding experience of caring for vulnerable populations. Multiple partnerships have been established over the years within the central Connecticut region that have benefited both the university's nursing students and the affiliated agency, in addition to the individuals served. Utilizing knowledge related to the common health issues confronted by those faced with homelessness, faculty worked with community partners to discuss needs and create a plan involving nursing students, which specifically focused on vision and foot health.

The Friendship Service Center (FSC) is a major organization serving individuals impacted by homelessness in the city of New Britain; it has a long history of serving the New Britain community. Established in 1968, the center has grown considerably and currently provides multiple programs to meet the many needs of this population (Friendship Service Center, 2017). The Department of Nursing has had a long-standing relationship with this agency. In past years, nursing students have conducted health fairs, volunteered to serve meals, distributed winter clothing, and conducted blood pressure and diabetes screening at the center. An inquiry email was sent to the FSC program director providing information on the grant, as well as an overview of some of the preliminary ideas for the project that were generated by the nursing department faculty. An enthusiastic reply was received, and plans were made to meet with both the program director and the residential supervisor to discuss the proposed vision and foot screenings. During the meeting, FSC staff were extremely receptive to the event and provided helpful information about optimal time to schedule the event, publicity, and

logistics for station setup and patient flow. Documentation of support and detailed plans for the event were included in the grant proposal. After notification that the grant was awarded, faculty were in frequent contact via email with staff in the weeks leading up to the event as details were finalized. The FSC staff were also supportive and appreciative of the plan for program evaluation via survey and expressed an interest in sharing results with their board of directors.

The Department of Nursing has also had a long-standing relationship with the New Britain Lions club. Nursing students have worked extensively with the Lions over the years to assist with vision screenings at many events in the city. Similar to the process described above, leaders from the Lions club were emailed prior to writing the grant to determine interest in participation. Because the Lions club often provides vision screenings at community locations, such as schools and veterans' events, they were well poised to set up their mobile vision screening at the homeless shelter. After confirming availability with the Lions optometrist, our contact person at the Lions responded very positively to the initial inquiry and committed to the event. Once the grant was awarded, faculty were in close communication with the Lions regarding setup needs in terms of space, supplies, and student assistance. It was determined that individuals needing additional formal vision testing would have appointments scheduled at the freestanding city eye clinic and that grant funds would be utilized to purchase new eyeglasses for those in need. The Lions club was also aware of and supportive of the plan to evaluate the event in terms of participant and student impact.

The last partner in this project was foot care providers. In order to deliver safe and effective foot care, trained health professionals were sought out through networking and word of mouth. After conducting research on certified foot care nurses in the area, a nurse who specialized in foot care was contacted to see if she would be interested in assisting. A successful meeting was held to provide an overview of the project, discuss needed supplies, and determine the role students could play in assisting with the foot care. Because of the lack of certified foot care nurses in the area, two podiatry residents affiliated with a local hospital were also contacted. After learning about

the purpose of the project, all foot care specialists agreed to assist with this aspect of care at the shelter event. Their support was included in the grant proposal. Once the grant was awarded, the faculty were in close contact with the foot care providers during the time leading up to the events.

This initiative engaged members of the Student Nurses Association (SNA) as well as students in an Introduction to Nursing Theory course (Nursing 301). The SNA is committed to advocating for the health of local and national communities and seeks out opportunities to actively engage the community through volunteer service, health enhancement, and education. The SNA is predominantly composed of undergraduate prelicensure nursing students. Nursing 301 is one of the initial courses in the university's RN to BSN program. In this course, students study several nursing theories. Each particular theory is examined, evaluated, and applied to the health of individuals, families, and communities. Students study nursing theorists' conceptual models of health, illness, and wellness. Students craft their personal philosophy of nursing (grounded in nursing theory) and subsequently carry out a health promotion initiative in a setting of their choice based on their chosen nursing theory. Students from both the SNA and Nursing 301 were invited to participate in the Sight to Sole events.

Two events were planned and executed in fall 2018. The events occurred in the dining room at the homeless shelter and were promoted to individuals temporarily living in the shelter's transitional housing unit. An evening time slot was chosen, immediately after the dinner meal was served, in order to maximize availability of interested individuals. The event was advertised through word of mouth and through flyers distributed in the building. Further interest was fostered by the program director and by the residential supervisor.

Members of the Lions club and the foot care providers arrived early to set up equipment and orient students assisting with services. A registration station was created where interested individuals could learn more about what was being offered at the event and sign up for vision screening and/or foot care. A childcare station was also established, staffed by a student and supplied with crayons, puzzles, and games, for any children accompanying a parent at the event.

The vision screenings were conducted by students along with a licensed optometrist who is a member of the Lions club and volunteered his services for the event. Snellen testing was performed first to assess basic visual acuity. Machines were then used to screen for increased intraocular pressure and peripheral visual deficits, which can assess glaucoma risk. After these tests were completed, participants were screened with a nonmydriatic camera, which captured a photo of their retina and optic nerve. These images were reviewed by the optometrist, along with results from the previous screening tests, and a plan of care was established. Individuals needing reading glasses were given a free pair by the optometrist. Individuals needing additional formalized testing were referred to the eye clinic for additional evaluation at no cost. An arrangement was made for those needing prescription eyeglasses to have the cost covered by grant funds.

Comprehensive foot care services were offered. Individuals wanting foot care initially received a warm foot soak. The soak was followed by a thorough foot assessment, nail clipping, and callus removal if needed. Lotion was applied to calves and feet and all individuals were given three pairs of clean white socks. If an individual needed additional medical attention related to their feet, they were referred to the medical provider who visits the shelter on a weekly basis.

During the event, participants had the opportunity to socialize and relax, while enjoying refreshments and conversation with the students. A dessert table was set up where participants could make a yogurt and fresh fruit parfait if they so desired. At another table, participants were encouraged to stop and receive additional verbal education and written handouts related to vision and eye care prior to leaving the event. Small gift bags were assembled ahead of time containing nail clippers, lotion, antifungal powder, and nail files, all purchased with grant funds. Each participant received a gift bag when finished with the services.

Impact of the Project

A plan was developed to evaluate the impact of the project in terms of its four major goals. In order to evaluate Goal 1, improving the health of the homeless population in New Britain by providing interventions

which enhance vision and foot health of homeless individuals, data would be collected on numbers served, amount and type of screenings conducted, and referrals generated by the event. Goal 2 was to provide opportunities for students to engage in service-learning activities that included critical reflection and potential for personal growth. Plans were made to promote the events among students, solicit interest, and collect data on the number of student participants and placement in the program. In order to meet Goal 3, enhance student understanding of social determinants of health so that they may be better able to advocate to eliminate health disparities, participating students were asked to journal about the experience guided by several predetermined questions. Faculty researchers planned to conduct an analysis of the journals to determine to what extent this goal was met. Goal 4 was to exemplify the commitment to community engagement as defined by the Carnegie Foundation plan by fostering relationships with several community partners. The plan for evaluation of this goal was to solicit feedback from partners, share results through the community engagement program on campus, and disseminate details about the event for replication through presentations and publications.

Faculty also wished to get feedback from participants to assess their satisfaction with the quality of services and the care provided. Prior to the first event, the institutional review board (IRB) approval process was initiated in order to conduct a simple survey of participants. In preparation for formal IRB submission, the homeless shelter was approached to first gain support for the exit survey, which was granted and endorsed in the form of a gatekeeper letter. The IRB application was reviewed by the university IRB committee, and permission to survey participants was granted.

In order to assess the impact on students, students who attended the events were asked to journal about their experience and respond to specific questions related to personal reflection. IRB approval was also granted for this component of the evaluation. Students were told that participation was optional. Informed consent was obtained for those wishing to participate.

Students choosing to participate in the evaluation process were asked to answer the following questions:

1. Did you have preliminary presumptions about working with homeless clients? If so, please describe. How have your ideas changed, as a result of your service?

2. Describe how this learning experience provided opportunities for you to incorporate knowledge from your courses thus far.

3. Did this service-learning experience change your attitude about volunteerism in a positive or negative way? Explain your answer.

4. Through this experience, do you think you made a contribution to the individuals at the FSC? Why or why not? Describe your level of involvement, any collaborations that you had with others and the accomplishments of your actions.

5. What are some important points that you learned from this experience? Please add anything else you would like to share.

Community partner feedback was also recognized as an important aspect of this project. Plans were made to discuss the events with the partners from the FSC, the Lions club, and the foot care providers after the events ended in order to better understand what worked well and what could be improved upon for future events of this nature. The nursing instructors also planned to meet after each event to evaluate the event and modify various aspects as needed.

Findings

Goal 1: Improve the health of the homeless population in New Britain by providing interventions which enhance vision and foot health of homeless individuals

A total of 27 individuals (15 women and 12 men) ages 23–75 received care over the course of the two evening events. The mean age was 47.6 (SD 15.5). Additional demographic information, such as the presence of diabetes or hypertension, was also collected on the 27 individuals who attended both events. A total of 25 (92.6%) individuals chose to receive vision screening. Of these, 21 individuals (84%) were referred to the eye clinic for an in-depth evaluation and/or new eyeglass prescription. A total of 13 individuals received comprehensive foot

Table 1. Sight to Sole Event Demographic Data (*N* = 27)		
Gender	***n***	**%**
Male	15	55.6
Female	12	44.4
Age		
20–29	6	22.2
30–39	4	14.8
40–49	2	7.4
50–59	9	33.3
60–69	4	14.8
70–79	2	7.4
Reported Conditions		
Diabetes	4	14.8
Hypertension	10	37
Vision Issues	19	70.3
Foot Issues	10	37
Services Received		
Vision Screening	25	92.6
Foot Care	13	48.1
Note: Totals may not add up to 100% due to rounding.		

care and nail clipping. See Table 1 for demographic data. One individual required a referral to the medical provider who attends the shelter on a weekly basis for a more in-depth foot evaluation and referral due to extremely ingrown and thick toenails. The vision screening and foot care services provided, as well as the referrals made, served to meet Goal 1 of this project. At the conclusion of the event, individuals were invited to complete a survey that used a Likert scale to evaluate their satisfaction with the vision screening, the foot care services, and their overall experience regarding the event. In general, participants receiving care identified high levels of satisfaction with the services provided by the nursing students and healthcare providers. All participants reported that they were treated with respect during the event. Table 2 shows questions asked of the participants and their responses. Very positive informal feedback was also obtained by and through the staff at the shelter the day after the event and shared with faculty.

Goal 2: Provide opportunities for students to engage in service-learning activities that include critical reflection and potential for personal growth.

A total of 15 students participated in the two events. As previously noted, nursing students voluntarily journaled about their experiences providing care to the homeless. Students were able to use this opportunity to engage in self-reflection and applied concepts of nursing theory to the actual event. Journal quotes that capture this objective include the following:

"I reflected back to Nola Pender's theory of health promotion and see how this is a perfect environment to use this theory. It is a supportive atmosphere to offer healthy meals, encourage self-care and promote good self-esteem."

"The learning experience from attending the friendship center provided me an opportunity to provide care and serve people or the

Table 2. Sight to Sole Event Satisfaction Survey (*N* = 17)				
	Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**
I was greeted and made to feel welcome			17.6%	82.3%
The available services were explained to me			17.6%	82.3%
I was treated with respect during the event				100%
I learned helpful ways to care for my feet (if received foot services)*		16.6%		83.3%
I received information about my vision (if testing done)**			12.5%	87.5%
My questions were answered in ways I could understand			23.5%	76.4%
The students and staff seemed interested in my health and wellbeing			17.6%	82.3%
This event was worth my time			11.7%	88.2%
*6 responses **16 responses *Note:* Totals may not add up to 100% due to rounding.				

community as I learned from Jean Watson's theory of transpersonal human caring in my class."

"In my setting I used to assume they were all looking for food and a warm place to sleep. In my specialty I find that most homeless people are intoxicated, have mental health issues, or both. To some extent this is true however over the years I've seen enough people off the streets to know that not all of them fall into these categories. I think that spending time at The Friendship Center showed me even more so that seemingly 'normal' people can end up homeless for whatever reason, not necessarily from alcoholism, drug addiction, or mental illness."

"Participating in this service to help the homeless community has been rewarding and positive. It changed my outlook and whole perspective on volunteerism in a positive way because it felt good to give back to the community and help those who truly need it."

"My experience at the Friendship Center reinforced a positive attitude towards volunteerism. At the Friendship Center you could see the follow through and support of providing holistic care."

"I did have some presumptions about working at the Friendship Center. I thought the facility would look more rundown and that the clients we were serving would not trust us, but to my surprise a lot of people wanted us to care for them. After working at the Friendship Center I realized that our service was wanted and appreciated by all who received our services. This was also a good learning experience from a course I am taking this semester as well. I have learned many different nursing theories this semester and from what I observed at the Friendship Center is that the Basic Need Theory still stands true today."

Goal 3: Enhance student understanding of social determinants of health so that they may be better able to advocate to eliminate health disparities.

In addition to discussing how they applied classroom theory to this experience, nursing students also wrote about how small acts of kindness can serve to instill hope and trust in others. Concepts of social justice and vulnerability, as well as the importance of advocacy to enhance the health of others, were evident in their journals, all serving to meet Goal 3 of this project.

> "The Friendship Center can help more homeless and assist families in finding permanent housing, jobs and help to navigate the system so they can get the temporary services they needed."

> "It is well known that homeless people are a diverse population who are more prone to physical and mental ill-health and who experience poorer engagement with health and health promotion services. Therefore, they are often missed by primary care health appointments due to lack of insurance or even access to primary health doctors."

> "Many of the clients that stay at this facility have trouble accessing healthcare. They lack any primary care and rather than wait for them to seek care on their own, this outreach program brings it to their doorstep. While it's not definitive care, it opens up the door to get them to where they need to be. The health screenings help facilitate and promote health and well-being."

> "I feel like we all made enormous contributions to the residents at The Friendship Center. They could see the sincerity in our desire to help them and it uplifted them."

> "The one thing I found with every resident I came in contact with was their pleasure in having been helped, it was as if for once they could see some hope in their lives even if it's for something as simple as getting a new pair of reading glasses. Every single one of them

smiled as they left our station."

Goal 4: Exemplify the commitment to community engagement as defined by the Carnegie Foundation plan by fostering relationships with several community partners.

Carnegie defines community engagement as "the collaboration between institutions of higher education and their larger communities for the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity" (Driscoll, 2008, p. 39). This project linked CCSU with the New Britain community in mutually beneficial ways as described above, aligning well with this definition. All partners worked together with the faculty and students, demonstrating role flexibility in order to deliver care as a team. An exchange of knowledge and resources did in fact occur as a result of this project. Both the Lions club and the foot care specialists depended on the student volunteers to assist with the vision screenings and foot care services. Students learned important factors related to healthcare needs of the homeless as they prepared for this experience. They also gained knowledge and skills related to vision health and foot care practice as they worked alongside the optometrist and the foot care specialists. The shelter staff were happy to have services provided right in the shelter, as this made the specialized care delivery much more convenient. Participants received important health education information as they rotated through the various stations. Feedback from the Lions club members who attended the event, as well as the foot care specialists, was very positive. Shelter staff also confirmed their own high level of satisfaction with the event overall in terms of organization, services, student interactions, education, and supplies provided.

Implications of Early-Stage Assessment

Overall, faculty members believe this project was very successful on many levels. Aside from the positive outcomes shared above, there were numerous additional and unanticipated benefits. Nursing curriculum in particular is especially enhanced when community engagement activities are embedded into the program, as these experiences can serve as a significant means of integrating the American Association of

Colleges of Nursing (AACN) Baccalaureate learning outcomes. The AACN recognizes that an important role of the Bachelor of Science Nursing (BSN) program is to "determine and assess clinical sites to ensure the clinical experiences for students provide: patients from diverse backgrounds, cultures, and of differing gender, religious, and spiritual practices" (AACN, 2008, p. 35). The AACN also states that BSN programs should provide opportunities for students to advocate for social justice, including a commitment to the health of vulnerable populations, such as the homeless, and the elimination of health disparities. Programs such as the Sight to Sole program, which emphasizes health screening and health promotion, can play a small but significant role in addressing this need.

An unexpected benefit of this project was the mentoring process that occurred between the two levels of nursing students. This service-learning opportunity provided licensed RN students who were in Nursing 301 the opportunity to serve as leaders and mentors to the prelicensure nursing students in the SNA as the two groups worked side by side to deliver care, a unique arrangement not previously occurring in the program. Additional combined community engagement experiences such as this can serve to build strong collegial nursing relationships within the CCSU nursing community in addition to the local central Connecticut community.

This experience also served to bring classroom content and theory to life. In addition to the direct benefits for those experiencing homelessness, students applied theories of health promotion, illness, and wellness to the care of these individuals at the FSC. The students utilized the health promotion model to provide health education and screening, specifically vision screening and foot care. Rather than simply learning about health promotion from class lectures, these students actively applied the theory of health promotion by fostering optimal health in the homeless population through education and health screenings at the FSC while applying important therapeutic communication techniques and empathy to the encounters.

Next Steps

Although this was not a large-scale project, the activity did serve to meet the stated goals. This project has great potential in terms of impact on future students, as well as individuals served. Plans are currently under way to hold an additional event where the main focus will be on foot care, as the majority of individuals already had undergone vision screening and recently received referral information. Faculty are also hoping to plan a future event that focuses on holistic care, where services such as massages and a yoga class can be combined with education regarding positive stress management techniques such as deep breathing, mindfulness, and simple meditation.

Interdisciplinary collaboration is recognized as a critical aspect in achieving positive health outcomes (Jakubowski & Perron, 2018). The potential to collaborate with other disciplines at the university is promising and exciting. Departments in the fields of social work, exercise science, and psychology, for example, would be excellent partners to collaborate with on further initiatives.

The positive outcomes of this project will be used to foster enthusiasm for future events at the local level. The benefits of this community engagement activity will be shared with other faculty members at the university, where involved nursing faculty members serve as a resource for others who may be interested in organizing such events to assist the homeless in the surrounding community. In addition, the project and outcomes will be disseminated at national nurse educator conferences so that other schools of nursing can look to create opportunities such as these to benefit both their students and their communities.

To keep the project momentum moving forward, faculty members plan to apply for additional grant funding through the Faculty Senate Community Engagement Committee as well as the university's grants department to obtain local community funding (community engagement grants are offered annually). Although all health-related screenings are valued, the shelter expressed a significant need for ongoing foot care clinics. Additional grant awards may therefore be used to hire a certified foot care specialist nurse. Faculty have also considered applying for a professional development grant, offered yearly, for a member of the nursing department to become a certified foot care specialist nurse through the American Foot Care Nurses Association (AFCNA). Certified foot care specialist nurses remain in high

demand in Connecticut, as evidenced by the AFCNA website, which as of this writing listed only three local practitioners in the entire state (https://www.afcna.org/FindFootCareNurse?&tab=1). Having a trained faculty member who could offer the ongoing services free of cost would truly enhance long-term sustainability of this project.

The participation of the Lions club, which offers the services at no cost, and continued involvement of nursing students in the RN and RN to BSN programs also serves to promote long-term sustainability of the Sight to Sole project. Nursing faculty will continue to recruit students from academic classes and the Student Nurses Association. Students have the opportunity to engage in the community through social justice and clinical nursing. Individuals experiencing homelessness will receive foot care, vision screenings, and health education at no cost. The Sight to Sole project has ongoing potential to provide valuable outcomes for the students and faculty of the Department of Nursing, the university, and the community at large.

Lessons Learned

Overall, this project aligned well with the university's commitment to having a positive impact on the surrounding community. The homeless shelter staff reported that this was a valuable service delivered in a convenient manner and indicated that they would welcome future projects such as this. Faculty were thrilled to learn that interactions with the students and providers were rated as extremely caring and respectful by the individuals receiving services. It was discovered that community partners such as the Lions club are eager to assist in projects such as these, as they align well with their mission to "support the efforts of Lions clubs and partners in serving communities locally and globally, giving hope and impacting lives through humanitarian service programs and grants" (Lions Clubs International, n.d., para 1).

Having two separate events was beneficial in that the first event offered an opportunity to determine what worked and what did not. As a result, the second event ran more smoothly than the first. For example, the lighting for one of the eye screeners was not optimal for the optometrist in the first event: The screening needed to be held in a darker environment. This issue was communicated to shelter staff, and special arrangements were made to relocate the nonmydriatic camera for the second event. Faculty also realized that a few more students were needed for the second event in order to place one student per station, with two additional students assigned to a greeting table where they were notified about services, which worked well. In addition, at the second event, the exit table was combined with the dessert table and relocated in a more convenient area to encourage more people to stop there and receive health education.

This community engagement activity was especially meaningful to the nursing students who participated. With the majority of student learning experiences occurring in the sterile environment of the hospital setting, events such as this can take students out of their comfort zone and enhance awareness of the multitude of needs of individuals in their community, individuals who often have issues much different from their own. In addition, students learn that during events like this they need to be flexible in their roles and "go with the flow." They quickly learn that unexpected obstacles can occur and that mild chaos, especially when running an event such as this for the first time, is typical. Problem-solving skills are developed and enhanced as the team works together to ensure positive outcomes. There is a call for nurses to be mindful of the needs of vulnerable populations and the current health disparities that exist in the United States today (AACN, 2008). Meaningful opportunities to work with individuals from diverse backgrounds in the community setting can develop through community partnerships and serve as valuable experiences for students, regardless of their majors. Universities who embrace elements of community engagement can easily support interested faculty by offering grant opportunities and resources for success. Such support can serve to initiate creative and engaging activities in practically every discipline, for multiple benefits to the university and surrounding community.

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Service-Learning Through Immersive Technologies in Ecuador

Veronica Yepez-Reyes and Eric R. Williams

Abstract

Service-learning, as a form of experiential learning, allows universities to work hand-in-hand with local communities, addressing their needs and expectations and putting into practice professional skills acquired by the students. This article reports on two service-learning experiences of communication students and faculty of Ecuador and Ohio, United States working together with local communities in the countryside of the coastal province of Manabí and in the Andean páramo of Chugchilán. These activities were further enhanced via cutting-edge immersive technologies and production experience using these technologies. This article aims to answer the questions of whether and how international stakeholders and immersive technologies play a role in the community outreach roadmap. The outcomes suggest that immersive technologies in service-learning international partnerships present four types of challenges: ontological, technological, narrative, and professional. The introduction of immersive technologies in service-learning projects is an interesting possibility for further development of joint narratives.

Keywords: service-learning, communication studies, media technologies, international partnerships

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Undergraduate students in Ecuador must undertake two types of community outreach projects during their academic career: workplace internships and community engagement projects. It has been possible to find internships, also known as apprenticeships, from the very dawn of creation, as knowledge passed from one generation to the other. However, as Sides and Mrvica (2017, p. 1) highlighted, "the immediate past century or so may have been an aberration—a time in which learning was inculcated more and more frequently through lectures and books than through experience." Acquiring knowledge through experience has been reinvigorated in undergraduate curricula, and community engagement is recognized as scholarship. Welch (2019) described community engagement involving activities for the benefit of society that, at the same time, have academic purposes. Community engagement both generates new knowledge through research and educates in programs of study.

One of the main goals of community outreach projects is sharing knowledge between stakeholders. Other goals include critical reflection about the context of the project, the inclusion of public interests, and the opportunity for students to practice professional skills.

In 2017, the College of Communication from Pontificia Universidad Católica del Ecuador (PUCECom) began working with Ohio University's Game Research and Immersive Design (GRID) Lab to develop community outreach opportunities that involved immersive and virtual technologies. In today's digital world, these sorts of international relationships could create transformative learning experiences for communication students on both sides of the relationship. Further, service-learning projects and immersive technologies seem to work hand-in-hand to invigorate the students' nonfiction storytelling skills in the field. Over the course of 2 years, both universities developed the foundations for future projects.

Three main topics compose the framework of this article: (a) service–learning, (b) storytelling, and (c) immersive technologies—each interconnected with the international partnership to play a role in the community outreach roadmap.

The Field of Service–Learning

Community engagement projects frequently use one of many different active methodologies—problem-based learning, service-learning, learning by doing, and action research, among others—to perform their activities with the involvement of participants from outside higher education institutions. The methodology of service-learning, as a frontline practice of experiential learning, has been applied to interdisciplinary community engagement programs since 2017 at PUCE, suggested by its partner, the Center for Campus and Community Engagement from Ohio University.

Service-learning is defined as a twofold strategy that combines performing some type of (professional) service with a specific community and the academic learning outcomes of its enactment. Jacoby (2015) explained it as "a form of experiential education in which students engage in activities that address human and community needs, together with structured opportunities for reflection designed to achieve desired learning outcomes (p. 1)." Tapia (2016) argued that acquiring knowledge through experience has reinvigorated undergraduate curricula around the world. Perhaps this is because service-learning encourages critical reflection and a responsible commitment of all stakeholders to social transformation. Here the university–community relationship is woven into proximity and mutual recognition of collaborative horizons (Andrade et al., 2019). Critical reflection and reciprocity are necessary conditions for the methodology to function optimally.

Within service-learning, community-based projects have manifold benefits: for students, an excellent field experience; for students and communities, technical support and transfer of knowledge. Moreover, Fung (2017) pointed out that service-learning hinges upon the development of "assessment criteria for learning from mistakes and difficulties, as well as from obvious successes" (p. 91). At PUCE, significant learning blends together teaching, research, management, and community outreach in

line with the proposal of university social responsibility instituted by AUSJAL (2014, p. 16)—the Latin American network of Jesuit Universities—based upon four criteria:

1. *Lived experiences.* University students, faculty, and staff make direct contact with communities, especially with vulnerable groups in society.

2. *Critical analysis of historical, cultural context and environmental issues.* From a local vision with a global perspective, this criterion puts special emphasis on understanding the causes of a low generation of opportunities and well-being for the great majority; it also refers to issues of exclusion, power imbalances, and governance.

3. *A high level of technical and professional skills.* Availability of such skills deepens the ability to design successful solutions in each field of knowledge, being aware that goodwill alone is not enough with goodwill for the success of projects and programs. Ethical issues are also raised within this criterion, since a technocentric view could be inappropriate in different contexts. This applies also to moralism, which, without relevance and academic excellence, can even bring greater harms.

4. *Public interest.* This is a transformational space for professional work. Knowledgeable professionals provide vital support to advance public interests. Open access, inclusion, and awareness are key issues.

Significant higher education blends together the four substantive functions of teaching, research, community outreach, and management, all of them with a humanistic person-centered aim. In this scenario, the field of service-learning is located at the intersection of teaching and community outreach. Working on problems and needs of the communities is in the basis of a joint venture that relies on knowledge exchange among all stakeholders. Communities, students, and faculty, performing together with a shared goal and scope, could enact the development of effective responses and evolve into positive transformations in an iterative and harmonious cycle, as shown in Figure 1.

At PUCE, community engagement has been a common practice associated with the doctrine of social justice and performed
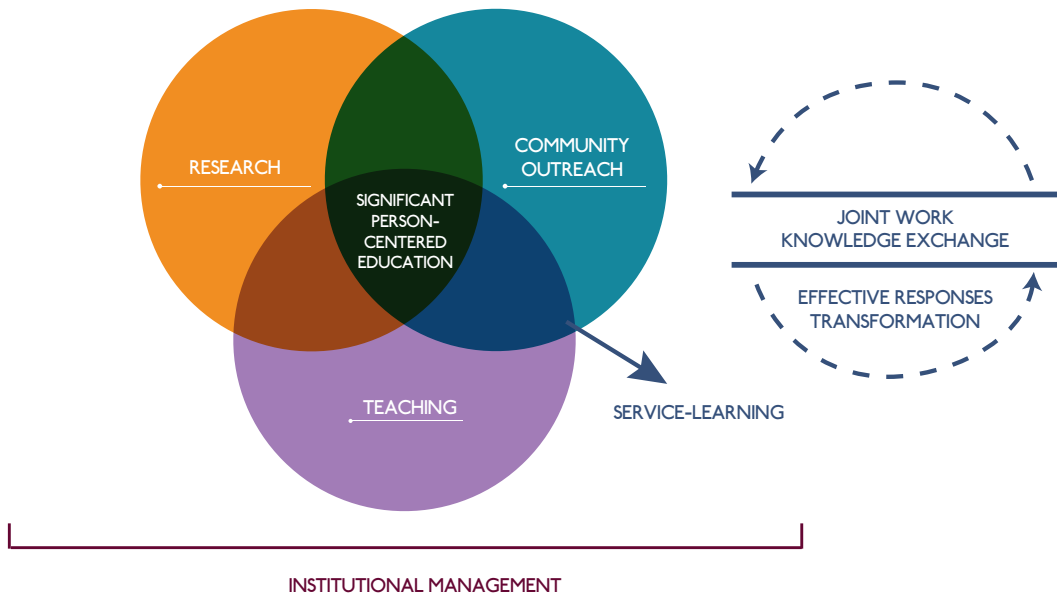
Figure 1. Service-Learning in Higher Education
Note. Adapted from González et al. (2019).

through programs of institutionalized volunteering over time.

International Partnership in Service-Learning

One of the issues raised by Jacoby (2015) is international partnerships for service-learning, as many universities, particularly from the global North, promote service-learning programs abroad. International partnership for service-learning involves greater challenges than domestic community engagement, including timing, traveling, and dealing with unfamiliar environments, cultures, and languages. It is important that the quality of the service offsets the agency time spent in organizing, planning, and supervising the project, and, most importantly, it is fundamental that service-learning turn into a meaningful experience for all stakeholders. Local and international students need to grasp the essence of what they have engaged; this includes its significance in their personal and professional lives. Faculty need to reach the learning outcomes proposed for their courses so that leaving the campus, and all its facilities, is worth the effort. Community members need to find meaning in the experience, as they will spend time and effort working on issues that are rather different from their daily life and could lead to a desired transformation.

The partnership between PUCE and Ohio University started in 2000 around a research project investigating Chagas disease. This partnership was bolstered in 2015 through a new agreement involving additional colleges from each university, including PUCE's College of Communication, Linguistics and Literature (PUCECom) and Ohio University's Game Research and Immersive Design (GRID) Lab in the Scripps College of Communication. Together, these two entities agreed to design collaborative community outreach projects.

In 2018, Ohio University applied for the Carnegie Classification for Community Engagement. In the application, they explained that community engagement is about mutually beneficial partnerships between communities and students, staff, and faculty to harness the practices of teaching, research, and engagement in a way that supports (a) sharing knowledge and resources, (b) commitment to partnership and reciprocity, and (c) transformative outcomes for the community partners and Ohio University.

Ohio University's Center for Campus and Community Engagement has a threefold motto: learn, serve, engage. It helps students, faculty, staff, and community (from local to global) to create jointly designed, mutually beneficial partnerships that foster

resilient communities and lifelong engaged citizens. PUCE shares this common commitment to community engagement.

Smith-Tolken (2019) suggested that service-learning demands the active participation of at least four different groups of stakeholders with various purposes: (1) university students intent on learning, (2) faculty and staff to facilitate the learning, (3) representatives of social organizations working with the community, and (4) members of the communities involved in the activities.

However, the PUCECom–GRID Lab coalition proposed a new paradigm, one in which there was a fifth important stakeholder: students and faculty from an international university, working in partnership with the local university. The coalition of communication partners proposed two joint service-learning projects to put the new paradigm to the test. Both projects involved community-based storytelling and cutting-edge immersive technology.

Developing Immersive Storytelling in Service-Learning

Nonny de la Peña is considered a pioneer in immersive storytelling. In 2010, together with a group of scholars and practitioners, they introduced the concept of immersive journalism as "the production of news in a form in which people can gain first-person experiences of the events or situation described in news stories" (de la Peña et al., 2010, p. 291). Wendy Suzuki, professor of neuroscience and psychology at New York University, and her colleagues (2018) posited: "The personal narrative detail that is often at the heart of a good story is one of the most powerful forms of communication that exists" (p. 9468). The service-learning international group was intrigued to see if they could use the ideas of immersive journalism—specifically to infuse a sense of first-person experience—in combination with the power of personal narrative to tell compelling stories about countryside communities in Ecuador.

Two international service-learning projects took place during the summers of 2017 and 2018. In both years, service-learning designs in the field of communication were proposed to enhance existing community outreach projects from other colleges at PUCE (Psychology, Medicine, and Nursing)

with communication products. For this reason, communication designs were discussed together with faculty and students from the colleges involved, as well as the local communities interested in the products, focusing on relevant stories that could be told.

Manabí

In Manabí, a team of 25 undergraduate journalism students and four faculty members from PUCE collaborated with a smaller team of one master's student and one faculty member from Ohio. Together the 31-member team worked with rural coastal communities on the project titled "Repowering Manabí." The aim of this project was to use traditional and immersive media to celebrate the resilience of the people of Manabí, who had experienced a 7.8 earthquake (April 2016) and one of the strongest rainy seasons in years (February 2017). PUCECom provided traditional still cameras, audio recorders, and video cameras, and the GRID Lab provided audio and video cinematic virtual reality (cine-vr) equipment.

Students were divided into six teams covering different activities of the population addressed: agriculture, health services, salt making, tourism, fishing, and archaeology. The tutors were the faculty members and the graduate student from Ohio. Each team was expected to include material for traditional media (video, radio, and press) as well as an immersive cine-vr experience. Before the team traveled to Manabí, a one-day workshop was held at PUCE to familiarize each team with the cine-vr equipment. All team members agreed to speak Spanish in the field. Both Ohio members were fluent in Spanish.

Each team worked with one tutor and one community member. Keeping in mind that with service-learning projects, students and faculty do not work for the community but with them (Ríos et al., 2016), each team included at least one community member who was able to play an active role in the storytelling process. Community members joined each team in Manabí, where they contributed their extensive knowledge about the places and people.

Problems began almost immediately—starting with the technology and quickly expanding. From the beginning, the smartphone app needed to view the cine-

vr images did not work. The cameras were unable to communicate with the teams' smartphones. The app is not needed for recording, but it is a psychological safety net for the camera operator. When the app did not work, those new to the technology (the PUCE students and faculty) quickly abandoned the cine-vr cameras altogether and continued their work using their traditional media equipment. The Ohio team members continued using the cine-vr equipment, but they were unable to share their footage with anyone. This technological split seemed to divide the teams.

It is important to mention that four of the six teams were 100% PUCE students and faculty (in collaboration with Manabí community members). These teams functioned well but ignored cine-vr entirely. In the two teams where Ohio members functioned as tutors, PUCE students chose to follow the advice of the Manabí community member instead of their tutors. Although language was not an issue, the teams experienced a "local versus foreigner" rift. In the end, these teams produced both traditional and cine-vr stories but did so separately. The PUCE students neglected the cine-vr equipment; the Ohio team members embraced the technology. The Ohio and PUCE team members did not work together very much in the field. At the end of the trip, the PUCE students returned to Quito and the Ohio members returned directly to the United States.

The project concluded months later, in October—but in two very different ways. In Quito, the PUCE faculty organized an event to share the finished products with the Manabí community. The Manabí community members were invited to Quito to meet all of the PUCE students and faculty who participated in service-learning projects over the previous year (from departments including Psychology, Economics, Pastoral Care, and the Health Institute) as well as those from the summer media program. The central spotlight of the event was a display of videos, books, and audio programs from the Communication students, enhanced with posters and research results from the other fields. Representatives from the communities of Manabí attended and were invited to return to their communities with the various media. This celebration became an opportunity to discuss future collaboration between rural communities and academic groups. All the videos produced are available in a YouTube playlist: https://bit.ly/manabi_17. The radio chronicles are available in an Ivoox playlist: https://bit.ly/cronicas_manabi.

Unfortunately, cine-vr videos were not included in the exhibition at that time, nor were representatives from Ohio present, as the summer had ended. Nevertheless, the master's student completed his cine-vr work upon his return and highlighted the resilience of the people of Manabí on his website: https://www.castillo.photography/Pechichal/.

In the autumn of 2017, an assessment of the service-learning activity took place at PUCE. The Identity and Mission Department conducted an open conversation about the experience with faculty and students. The key takeaways from the conversation were that (a) a majority of the PUCE students enjoyed the project and were proud of the outcomes, and (b) a majority of the PUCE faculty felt that the production-based objectives of the project were successfully met, but at the expense of the learning objectives of getting students to work together as a team.

Guayama Grande

In Guayama Grande, a year later, a new group of 24 students and the same four faculty from PUCE worked with a new team of two faculty and one undergraduate student from Ohio. This project was designed to collaborate with community members of Guayama Grande, Chugchilán, a highland village in the Andean province of Cotopaxi. This community had worked in service-learning projects before with other colleges from PUCE, and community members were eager to receive communication students with the aim of promoting their region as a hot spot for community-centric agrotourism.

As before, PUCECom provided traditional still cameras, audio recorders, and video cameras; GRID Lab provided audio and video cine-vr equipment. However, from the outset, the project design underwent four significant changes.

1. *Group assignments.* In Guayama Grande, PUCE faculty members were the tutors for each group, and the Ohio members worked with the PUCE faculty from each group. In essence, the Ohio team floated from group to group as needed. In 2018,

there were four groups and each group was assigned one of four specific topics: tourism attractions, experience-based tourism, ecological farms, or ancestral knowledge. However, each group was able to choose the media they wanted to use to best cover their topic area. Students were not required to use cine-vr equipment, but they could if they wanted to. A key difference from the groups established the previous year was the form of community member involvement. In Manabí, community members chiefly contributed local cultural knowledge. In Chugchilán, however, community members were deeply involved and interested in media production. All of the work would eventually be presented on a website to be managed by the community of Guayama Grande so that they could broadcast information about their facilities for experiential tourism in the Andean páramo. The resulting webpage is now available at https://guayamagrande.wordpress.com.

2. *Technology investment*. After the summer of 2017, PUCE purchased a cine-vr camera which was used with communication students at PUCE. This sparked their interest in the technology and made cine-vr less daunting to the students who participated in 2018. Additionally, the GRID Lab agreed to donate four cine-vr cameras to the PUCE program. This changed the PUCE students' relationship to this equipment. This new sense of ownership encouraged the students to think about cine-vr differently. In 2018, they were learning how to use their own equipment—not equipment that would disappear at the end of the summer.

3. *Team building and logistics*. A training day in Quito took place before the project began, but the logistics differed from the past experience in three ways. First, faculty ensured that the technology (especially the smartphone apps) was working and would continue to work in remote locales. Second, Ohio faculty put the students in charge of the cine-vr equipment before they left for Guayama Grande and encouraged them to experiment with it during the daylong bus ride. Along the way, the Ohio faculty were constantly providing guidance and tips about cine-vr, which inherently created team-building connections. Third, there was an arrangement for the Ohio group to return to Quito and offer a 2-day postproduction training session. Not only did this provide 3 days of training for the PUCE team members (instead of one), it also created bookends for the teams. All the group started together in Quito and ended together in the same place. This seemed to solidify a team approach to the project—even if the website would be created after the Ohio team left.

4. *Language issues*. Although unintentional, changes to the use of a "team language" seemed to play an important role in the group dynamics. In 2018, the teams agreed to speak in English since the Ohio faculty could not speak Spanish. This actually worked out well, as the mother tongue of the locals is Kichwa—the indigenous language of the Andes—and other PUCE faculty and students were in Guayama Grande on their own service-learning project to teach English to community members in charge of hosting international tourists. With most team members communicating in their secondary language, there seemed to be a growing sense of camaraderie. It is also worth noting that many conversations were multilingual, with people excited to learn each other's language, whether Spanish, English, or Kichwa.

In the end, the 2018 project seemed to be the inverse of the 2017 project. The community was very pleased with the resulting website, and the students were pleased with their work. However, cine-vr content was not a part of the final product—but for a very different reason. In 2018, a wide variety of footage was captured, and some of it was initially processed in the postproduction workshop in Quito. Unfortunately, once the Ohio team left, the technical processes were too cumbersome for the PUCE computer labs and, with a tight deadline to complete the website, cine-vr was abandoned.

Nevertheless, the PUCE faculty felt that the 2018 project was much more successful in building teamwork experience for the students. In the end, the faculty (both PUCE and Ohio) believe that the media production is only a small part of what service-learning is all about. Learning to work as a team (with the community and with each other) is the real learning objective.

Table 1. Students' Perception of Community Engagement Project					
Questions	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
The project responded to previous defined planning?	10	4	2	0	0
Work with the most disadvantaged sectors was prioritized, promoting their development and avoiding assistance-based practices or their instrumentalization?	9	6	1	0	0
Participation of other social actors and non-academic knowledge were included?	7	7	2	0	0
The project/program integrated various disciplines as a way to address complex issues?	12	4	0	0	0
The project resulted in changes or improvements in the beneficiaries' life (new solutions, increase of capacities, etc.)?	9	6	1	0	0

Note. Source: Community Outreach Department PUCE, 2018.

The project was assessed with a survey provided by the Community Outreach Department of PUCE conducted for students, faculty, and stakeholders. Unfortunately, the partners from Ohio were not included in the survey. The survey included five questions about perceptions of the activity performed, with answers on a Likert scale (see Table 1).

The survey also included a written reflection about the activity developed. The 2018 project offered a number of takeaways: (a) The experience was fruitful for nearly everyone involved, (b) international partners were perceived by students and faculty alike as peers, (c) many students "observed different realities" that helped them to develop new communication strategies, and (d) the idea of seeing "different realities" was a common refrain, with many students claiming that they experienced both professional and personal growth because the project allowed them to deal with problems outside daily university life.

It is important to highlight that none of the comments referred specifically to immersive technologies nor to the support received by the international partners. Reflections focused solely on the importance of teamwork in the field. The activities from both years were recognized as methodological innova-tion projects for communication studies by the university social responsibility network from AUSJAL in 2019, which is included in the 2019 compendium (https://bit.ly/ausj-alrsu_ApSCom19), and the video summarizing the activities can be found at https://bit.ly/SL_puceohiou.

Further study is warranted, but one interpretation could be that the international partners were not perceived as foreigners, but rather simply as other participants in the activity in the same way as community partners—just as the immersive technologies were no longer seen as an "external technological constraint," but rather as just another communication tool to consider.

Next Steps and Best Practices

The use of immersive technologies has been shown to promote participation in a collaborative activity (Fonseca et al., 2014). However, despite increased availability of immersive technology, relatively little research has been conducted to better understand how users (and practitioners) experience (and utilize) these technologies (Suh & Prophet, 2018). The projects reported deal with immersive journalism, using 360-degree video to enhance the audience's experience of the whole picture of the stories

told in a first-person fashion: meeting the people, observing the activities, and viewing the places.

As a starting point, researchers at PUCECom have identified four types of challenges facing immersive storytellers (Cruz et al., 2018):

1. *Ontological.* When talking about immersive journalism, one might think that the object of study lies in journalism and that immersion is secondary, considering it a feature that qualifies an old process. This perspective, however, fails to recognize both the mediating capacity of immersive journalism and its affordances in building (new) creative media. The ontological challenge is about allowing the agency of immersive journalism from where new narrative forms arise.

2. *Technological.* To popularize the consumption of immersive journalistic content, it is necessary to overcome the high costs of devices and platforms. Once this obstacle is overcome, the main technological challenge for journalists is daring to take the equipment in their hands, risk experimenting with new technology and new techniques, and learn by doing so.

3. *Narrative.* When audiences—curious not only about the news itself, but about the use of novel technology—are introduced to an immersive environment, the audience becomes a participant in the news and will perceive with greater closeness the objects and subjects of the journalistic product. However, if the goal is to tell a story from virtual environments, the longer production time may be a detriment to the immediacy of news topics.

4. *Professional.* A number of questions arise from ethical, formative, and practical perspectives: How much of reality can be recreated without disturbing, and even offending, those involved in the news being told? What will weigh more, the spectacular or the subsequent end of the news? Does the journalist do it for public interest or to be more successful from using a striking technology? Are virtual environment developers also journalists?

Academics and practitioners must find the answers for the use of immersive and disruptive technologies based on the narrative needs and the demands of the audiences and media.

Introducing immersive technologies into community engagement projects creates interesting challenges for both faculty and students, in terms of both formal and informal learning objectives. In summer 2019, PUCE students were able to apply these technologies in the rural communities of Chimborazo. Unfortunately, it was not possible to replicate the previous international experiences. Nevertheless, making students aware of the public purpose of their education and enhancing technologies to go beyond the aesthetic to enhance the needs and projects of communities is the main challenge. Further evaluation into the actual scope and relevance of such immersive technologies is needed, but we believe that the outcomes of these two projects raise interesting questions for all stakeholders in the process.

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The Coastal Ocean Environment Summer School in Ghana: Exploring the Research Capacity Building Potential of a Higher Education Informal Science Learning Program

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Abstract

The development of informal science learning programs (ISLPs) is a growing strategy among scientists seeking to engage communities. However, little scholarship exists on higher education ISLPs, limiting best practices for program development. This article explores the perceived impacts for student learners and scientist instructors of an international ISLP focused on marine science, using a mixed-methods approach of questionnaires, interviews, a task-based focus group, and participant observation. Learners perceived an increase in research skills and knowledge, and identified positive impacts associated with networking and forming connections. Learners did not significantly change their attitudes toward marine science or beliefs about careers in science. Instructors felt they helped advance their field and perceived positive impacts from cultural exchange, whereas only a few identified professional development impacts. This study suggests that higher education ISLPs should focus on creating space for different types of connections and increasing how scientists' participation is valued within the profession.

Keywords: informal science education, capacity development, higher education outreach, Ghana

I n the past decade, the scientific research community has placed a greater emphasis on broader outreach activities beyond fundamental science (e.g., Boyer, 1996; National Science Foundation, 2018; Roberts, 2009). This growing interest may be partially driven by a demand from the public for science to address societally relevant problems (Roberts, 2009). Reflecting this demand, many international and national funding agencies have introduced guidelines that encourage, or in some cases require, a broader outreach component for research proposals (e.g., [South Africa] National Research Foundation, 2017; [U.S.] National Science Foundation, 2018). New funding avenues have also been established for research focused specifically on broader outreach (e.g., National Science Foundation, 2020), such as scientists engaging in K–12 curriculum development (Laursen et al., 2007). As societal and funding demands encourage scientists to become more engaged in their local and broader communities, scientists are increasingly turning to the creation and development of informal science learning programs (ISLPs; Fauville et al., 2013). Informal learning involves voluntary, or "free-choice," participation in educational activities in a variety of settings, such as museums, schools, and nature centers (Falk et al., 2007; Hofstein & Rosenfeld, 1996; National Research Council, 2009). An ISLP differs from other types of free-choice learning (e.g., aquariums, science centers) in that it is a more structured activity with an "organizational goal to achieve curricular

ends" (National Research Council, 2009, p. 173).

ISLPs can be designed to achieve a variety of broader outreach goals, such as engaging a nonacademic audience in scientific research or providing continuing education opportunities for K–12 educators (National Research Council, 2009). Given their more structured format and capacity to foster mentorships, ISLPs are also poised to become an effective tool for broadening global participation in science (Hernandez et al., 2013; National Research Council, 2009; Roberts 2009; Strigl, 2003). The disparity in advanced scientific research conducted around the world is remarkable. For example, in 2018, researchers at U.S.–based institutions published 27,758 papers in the natural sciences, whereas researchers at institutions in South America and Africa published 2,663 (Nature Index, 2019). International mentorship and collaboration between established scientists and aspiring scientists via ISLPs could begin to provide the requisite access to methods and technologies to advance global research and scientific understanding (Hernandez et al., 2013; Lewis, 2003).

The objective of this study was to document the range of perceived impacts experienced by participants, both learners and instructors, of one higher education ISLP whose self–identified goal is to develop marine science research capacity in West Africa. Understanding the full range of participant impacts can provide insight into how this scientist–driven ISLP is meeting its stated objective. Findings also offer the potential to provide more general recommendations for the design of other ISLP efforts. This project explored instructor perceptions and assessed learner changes in multiple key indicators. Specifically, this work focused on the ways in which this ISLP influences (a) learners' perceptions of their ability to perform research, (b) learners' attitudes toward marine science, (c) learners' self–assessed knowledge of marine science, and (d) instructors' professional development.

Higher Education Informal Science Learning Programs

Current Research

Although there is considerable research assessing youth and family ISLPs, there has been a "relative paucity" of research on adult programs (National Research Council, 2009, p. 174). Most research on adult ISLPs primarily concerns museums/science centers, citizen science, health, or teacher professional development programs (e.g., Bates et al., 2006; Jordan et al., 2011; Qian et al., 2018; Sachatello–Sawyer & Burton, 2002). Existing research is also often descriptive in nature, with few studies directly assessing learning outcomes (National Research Council, 2009). Moreover, many ISLPs are designed and led by science faculty who lack expertise in educational theory or practice to support developing a strong curriculum with learning outcomes or in the (largely) qualitative methods necessary to evaluate if and how programs are achieving their goals (Fauville et al., 2013). Hence, there is a need for research evaluating the impacts of higher education ISLPs.

Exploring Learner Impacts

Understanding learner perceptions of their experiences is critical for assessing how ISLPs are progressing toward their goal of scientific research capacity building. Indicators of scientific research success include knowledge, attitudes, research ability, and relationship forming. *Knowledge* has "personal, situational, and socially constructed dimensions," which means that it is often subjective (Perry et al., 2014, p. 108). Knowledge, encompassing both scientific content and career awareness, is a foundational component of individual capacity for scientific research (Kennedy & Odell, 2014). *Attitudes* are an individual's evaluations (e.g., favor, disfavor) of an object or issue (Fishbein & Ajzen, 2010). Attitudes toward science may be an even more important indicator since attitudes are often more "enduring" than knowledge (Osborne et al., 2003, p. 1074). Similarly, *research ability*, which encompasses students' perceptions of their ability to conduct research, is a critical indicator of future career success (Stajkovic, 2006). *Relationship forming* is another aspect of scientific research success since "scientific career attainment is a social process" (Lewis, 2003, p. 371). Relationship forming in ISLPs seems to occur in a three–tiered system: (a) socializing (i.e., making informal, cordial connections), (b) networking (i.e., making formal and informal professional connections), and (c) research partnership forming (i.e., making formal, collaborative connections). Research partnership formation, especially with international collaborators, is an important step for increasing scientific re-

search capacity worldwide (Nchinda, 2002).

Exploring Instructor Impacts

In addition to assessing impacts on student participants, improving understanding of impacts experienced by scientist organizers and instructors is another important facet of program evaluation. Although the body of research on scientists and broader outreach is expanding (e.g., Clark et al., 2016; Nadkarni & Stasch, 2013; Roberts, 2009), a gap remains in knowledge of scientists' perceptions of their outreach activities (Johnson et al., 2014). Understanding instructor perceptions of higher education ISLPs and how they are impacted by participation is important for ensuring program longevity.

Case Study: The Coastal Ocean Environment Summer School in Ghana

The Coastal Ocean Environment Summer School in Ghana (COESSING) is an ISLP primarily targeting West African university students and early-career scientists. The mission of COESSING is to develop capacity for advanced oceanographic research in Ghana, ultimately increasing representation of African scientists in the international marine science community. COESSING is organized and taught through a collaboration of primarily North American and Ghanaian ocean scientists. The weeklong program was founded in 2015 by an American oceanographer, supported through the educational outreach component of a National Science Foundation Career Grant. Funding currently draws from several sources within the United States, Ghana, and internationally. As a free-choice learning program (i.e., participation is not mandatory and does not result in formal credentialing), COESSING has seen its audience continue to grow and diversify over time. Beginning with approximately 50 Ghanaian university students, this program's audience has expanded to nearly 100 participants ranging from undergraduate students to senior professors from across West Africa.

Beyond the overall mission statement, COESSING has yet to clearly define learning objectives or outcomes for participants. The general structure of COESSING includes morning lectures on topics in ocean and environmental science (e.g., general ocean circulation, fisheries and aquaculture), afternoon labs (e.g., introduction to Python, physics of fluids), and a daylong field trip with basic oceanographic fieldwork. However, the specific itinerary of the summer school is dynamic and changes annually in response to requests of participants through oral and written feedback. For example, COESSING 2016 increased hands-on labs in response to feedback received after the 2015 program. Based on feedback advocating for a stronger research focus, COESSING 2018 implemented a two-track system. Attendees who chose the overview track participated in all of the scheduled lectures and labs, whereas attendees on the project track worked in small groups on a project with supervision from instructors. Project track participants could also attend lectures and labs that were of interest to them.

Even though COESSING regularly solicits feedback on general content and organization from participants, there was no formal evaluation structure in place to assess the ways in which COESSING is progressing toward its mission of developing scientific research capacity in Ghana. As with many informal science outreach programs, COESSING's organizers are all career marine scientists with limited formal training in educational program design and evaluation.

Methods

Setting and Participants

Ghanaian Host Institutions

COESSING is held annually in Accra, Ghana. The Ghanaian hosting institution alternates yearly between the University of Ghana (UG) and Regional Maritime University (RMU). UG is a public university located in the Legon suburb northeast of Accra's city center. UG is the largest university in Ghana, with more than 38,000 students, and it is among the top research universities in sub-Saharan Africa. UG is currently expanding and increasing its research output to achieve its vision of becoming "a world class research-intensive University over the next decade" (UG, 2018, "Our Vision"). RMU is a private international university located on the coast at the easternmost edge of Accra. Serving the countries of Cameroon, Gambia, Ghana, Liberia, and Sierra Leone, RMU focuses on training maritime professionals and enhancing the regional maritime industry. RMU has a growing focus on re-

search and is expanding its graduate school offerings. Three new master's programs in engineering were launched in 2019, and a hydrography program is in development (J. Adjetey, personal communication, August 2, 2018; RMU, 2019).

Participants

Participants were divided into two categories: learners and instructors. Learners were attendees of COESSING 2018 who participated in lectures, labs, and projects. A total of 103 learners participated in this study, with representation from six West African countries: Ghana (53%), Nigeria (38%), Cote d'Ivoire (3%), Cameroon (3%), Mali (2%), and Sierra Leone (1%). The number of learners reflects the 103 unique respondents across the three surveys administered in this study. There are no data to confirm whether all presurvey respondents attended COESSING 2018. These learners encompassed a diverse group professionally, with 34% undergraduate students, 15% master's students, 15% PhD candidates, 11% university professors or faculty, 13% employed in another science-related job, and 10% unemployed. Approximately 31% of these learners identified as female and 69% as male.

Instructors were participants involved in teaching and/or organizing COESSING 2017 and/or 2018. Nineteen instructors participated in this study, with 58% based at institutions in the United States, 32% in Ghana, 5% in Italy, and 5% in the United Kingdom. Instructors spanned all career stages, with eight early-career scientists (postdoc and assistant professor equivalency), five mid-career (associate professor equivalency), and six late-career (full professor equivalency). Instructors were 42% female and 58% male.

Data Collection

This study used a mixed-methods approach. Qualitative data collection included semi-structured interviews with instructors, a task-based focus group with selected learners, and participant observation field notes. A survey instrument with both open-ended and scaled questions was also administered to learners. Data for this study were collected during COESSING 2018 at UG, with preliminary and background data collected during COESSING 2017 at RMU. All data collection occurred in English and by the primary researcher.

Semi-structured Interviews

Interviews followed a semi-structured format that allowed the flexibility to follow leads, while ensuring all interviewees were asked about the same topics (Bernard, 2011). A total of 18 instructors were interviewed, representing 91% of the instructors who participated in COESSING 2017 and/or 2018. Fifteen instructors were interviewed in person during the program, and three instructors were interviewed by telephone after the program ended. Interviews were conducted using a guide of five multipart, project-specific questions to understand instructor perceptions of the summer school. All interviews were audio recorded with interviewee permission.

Task-Based Focus Group

During the 2018 summer school, a task-based focus group of "repeat learners" (i.e., learners who participated in COESSING in previous years) addressed two project-specific prompts: "Why did you decide to participate in this program again?" and "What are some of the longer-term impacts you have experienced from participating in this program?" Thirteen repeat learners self-selected to participate in the 75-minute session. A focus group method was used because of its ability to explore a particular topic in depth (Bernard, 2011). Repeat learners were randomly divided into three smaller groups of four to five learners each to complete a series of tasks. First, the repeat learners independently wrote down their responses to the first prompt. They next compared their answers with other members of their small groups. After comparing responses, group members compiled similar answers and ranked their final set of unique responses from least important to most important. The series of tasks was then repeated for the second prompt.

Participant Observation

Participant observation was conducted during COESSING 2018 to understand the nuances of interactions, various roles of participants, and "notable nonoccurences" that participants may not be aware of or not be able to clearly articulate (Frechtling & Sharp, 1997, p. 3-3). The participant observation protocol included observation (a) of the learners during lectures, (b) of the instructor–learner interactions during the work sessions for the project track, (c) during the labs and field trip with learners

and instructors, and (d) during meals with learners and instructors. Not all lectures, labs, and work sessions were documented because of timing overlap and the interview schedule. Brief handwritten notes were taken during labs, meals, and the field trip. More detailed typed notes that reflected on previous occurrences and documented the lectures were taken during lectures. Field notes included both objective observation and subjective responses of the participant observer to help identify and overcome researcher bias (Spradley, 1980). Field notes were also taken during COESSING 2017, but did not follow a protocol and were predominantly observational in nature.

Surveys

The mixed-methods written survey instrument (i.e., questionnaire) was administered to learners across three points in time: (a) 1 week prior to COESSING 2018 (pre), (b) on the last day of COESSING 2018 (post), and (c) approximately four months after the end of COESSING 2018 (post-post). The pre- and post-post-surveys were self-administered online, whereas the postsurvey was administered on site. Across the three surveys, there were 103 unique respondents. The presurvey had 79 respondents, the postsurvey had 76, and the post-post-survey had 30. Fifty-three respondents completed both the pre- and postsurveys, and only 23 respondents completed all three surveys.

These instruments were developed using program evaluation literature (e.g., Francis & Greer, 1999; Kardash, 2000; Moore & Foy, 1997), 2017 observational field notes, and learner responses to an open-ended feedback questionnaire from COESSING 2016 and 2017. Three Ghanaian instructors also reviewed the instruments to ensure cross-cultural understanding of content and face validity of questions.

The questionnaires measured learner beliefs and attitudes toward science, skills and abilities to conduct science, and perceptions of COESSING (e.g., expected opportunities and outcomes). Questions were grouped into five categories: learner demographics, perceptions of ability to use research skills, attitudes toward marine science, perceptions of scientists and science careers, and evaluation of COESSING. Demographic information was measured from a mix of multiple choice and open-ended questions to ascertain academic or professional level, city and country of origin, gender, and birth month and year.

Learner skills (perceptions of their ability to use research skills related to marine science) were assessed with 15 questions (e.g., understand marine science concepts, think independently) measured on a 4-point scale from 1 = *not at all* to 4 = *very capable of completing the task*. These research skills were closely adapted from Kardash (2000). Learner attitudes (attitudes toward marine science in general) were evaluated using five semantic differential questions (e.g., dislike–like, boring–interesting) measured on a 5-point scale with 1 as the most negative and 5 the most positive. Learner beliefs (perceptions of scientists and science careers) were assessed with a series of 10 statements (e.g., "Scientists work together to solve problems"; "A career in science would be fun") using a 7-point scale of 1 = *strongly disagree* to 7 = *strongly agree*. Belief statements were adapted from Francis and Greer (1999), Gogolin and Swartz (1992), Krajkovich and Smith (1982), and Moore and Foy (1997). Learner beliefs were also assessed with two open-ended questions, one addressing whether respondents intended to pursue a science career and one addressing the ways in which COESSING changed respondent thinking about science careers.

The last category of questions evaluated learner experiences during COESSING. A series of 12 statements (e.g., general marine science concepts from introductory labs, career opportunities outside West Africa) assessed learner expectations and perceived outcomes of general learning content ("learning"). In the absence of preidentified learner content outcomes, the extent of specific knowledge acquisition could not be measured. Learner expectations and perceived outcomes of other opportunities at COESSING ("opportunity") were assessed from 10 statements (e.g., network with Ghanaian professors, form research partnerships with international professors). Responses to both the learning and opportunity statements were measured on a 7-point scale of 1 = *strongly disagree* to 7 = *strongly agree*. These statements were project-specific and were generated from 2017 observational field notes and 2016 and 2017 learner responses to an open-ended feedback questionnaire. Two open-ended questions invited learners to list any other topics they wanted to or did learn about and other opportunities they wanted to or did

have. In addition to the learning and opportunity evaluations of COESSING, three open-ended questions on the post- and post-post-surveys assessed why respondents chose to participate in COESSING, why they would or would not participate again, and in what ways they have experienced longer term impacts from participation.

Data Analysis

Qualitative Data

All qualitative data (interviews, task-based focus group, participant observation field notes, open-ended surveys) were analyzed collectively. Interviews were transcribed, and the open-ended questionnaire responses were consolidated into tables. Once the data were digitized and compatibly formatted, they were analyzed using NVivo (ver. 12.3).

The qualitative data underwent three phases of coding (Maxwell, 2013). First, the data were case coded by data collection method and, for the instructors, by individual participant pseudonym. The next phase of coding was categorical, using a predetermined codebook based on research objectives (Appendix A). The categorical coding was an iterative process with new codes added as appropriate. The final phase of coding involved thematic coding within each categorical code. Research memos were then generated for each categorical code, describing patterns and observations about the thematic codes. These research memos were consolidated by research objective to generate theoretical memos. The theoretical memos synthesized themes across all qualitative data related to each research objective.

Quantitative Data

Due to the low number of learners who completed all three surveys (n = 23), only the pre- and postsurveys were analyzed (n = 53). Using SPSS (ver. 25), nonparametric Wilcoxon signed rank tests were conducted to compare the pre- and postsurvey results for the 15 measures of skills, 5 measures of attitudes, 10 measures of beliefs, 12 measures of learning, and 10 measures of opportunity. A significance level of $p <$ .05 was adopted, accounting for both the small sample size and Bonferroni correction (i.e., original p-value threshold of .10 due to the small sample size/2 points in time = .05; Vaske, 2008). Cohen's d effect size was used to understand the strength of the relationship, with an interpretation of .20 as a "minimal relationship," .50 as a "typical relationship," and .80 as a "substantial relationship" (Vaske, 2008, p. 109). The internal consistency of each of the five groups of variables measuring each concept was examined with Cronbach's alpha reliability analysis, and overall mean composite indices were computed where justified by an alpha coefficient above .65 (Vaske, 2008).

Results

Perceived Impacts on Participants

Learners

The learner-identified impacts of COESSING 2018 fall into six categories: research skills, attitudes toward marine science, beliefs about science careers, content knowledge, conceptual knowledge, and connections with people (see Appendix A for a definition of each theme). Although most of the data drew from the short-term perceived influences of COESSING on the learners (i.e., postsurvey), speculations can be drawn about longer term impacts from the 30 post-post-survey respondents and the 13 repeat learners from the task-based focus group. All qualitative evidence provided is representative of the data for each category; thus, there are only positive responses because no negative responses were provided (see Discussion section for further details). The method of data collection for qualitative evidence is indicated parenthetically.

Research skills. Prior to participating in COESSING, learners' average perception of their ability to complete the 15 tasks associated with research skills ranged from "slightly" to "very" capable (Table 1). The learners felt least able to "write a research paper for publication" and most able to "collect data." Postsurvey results showed an average range in perceived ability of "moderately" to "very" capable. Learners continued to feel least able to "write a research paper for publication," and they had the same low average for their perceived ability to "design an experiment." The highest average skill observed on the postsurvey was the ability to "orally communicate results."

The matching average means increased from the presurvey to the postsurvey for

Table 1. Wilcoxon Signed Rank Analysis of Pre– and Postsurvey Learner Research Skills							
	Presurvey		Postsurvey		Wilcoxon– test value	*p*–value	Cohen's *d*
Research skills variables	*M*	*SD*	*M*	*SD*			
Understand marine science concepts	3.25	0.88	3.53	0.54	2.62	.009	.38
Make use of the primary scientific research literature	3.17	0.98	3.36	0.65	1.31	.190	.23
Identify a specific question for investigation using research	3.08	0.90	3.38	0.72	2.70	.007	.37
Formulate a research hypothesis	2.90	0.89	3.15	0.78	2.22	.026	.30
Design an experiment or theoretical test of the hypothesis	2.81	0.93	3.08	0.84	2.27	.023	.30
Understand the importance of "controls" in research	3.10	0.98	3.29	0.75	1.67	.095	.22
Observe data	3.25	0.84	3.52	0.64	2.43	.015	.36
Collect data	3.40	0.77	3.53	0.78	1.15	.248	.17
Statistically analyze data	3.04	0.83	3.21	0.72	1.44	.149	.22
Interpret data by relating results to the original hypothesis	3.06	0.93	3.36	0.68	2.31	.021	.37
Reformulate your original research hypothesis	2.75	0.96	3.17	0.87	3.09	.002	.46
Relate results to the "bigger picture" in marine science	2.94	0.99	3.32	0.73	2.86	.004	.44
Orally communicate the results of research projects	3.17	0.94	3.60	0.63	3.65	<.001	.54
Write a research paper for publication	2.74	1.10	3.08	1.00	2.50	.012	.32
Think independently	3.28	0.70	3.47	0.67	1.88	.061	.28
Overall	3.06	0.78	3.33	0.58	2.86	.004	.39

Note. Variables are measured on a 4–point scale of 1 = *not at all* to 4 = *very* capable of completing the task. Shaded variables are significant at *p* < .05.

all 15 variables. The standard deviations for each variable decreased from the presurvey to the postsurvey (except for "collect data," which went from 0.77 to 0.78), so there was more consensus in the postsurvey. Wilcoxon signed rank analyses comparing the pre– and postsurvey means showed that 10 of the observed increases were statistically significant (*p*–values between .026 and <.001). The Cohen's *d* effect sizes for the significant increases ranged from minimal to typical. The most significant increase was in "orally communicate the results of research projects" (ΔM = 0.43, *p* < .001), with a typical relationship.

A Cronbach's alpha reliability analysis of the pre– and postsurvey skills variables revealed alpha reliability coefficients above .65 (Table 2). Removing any items from their respective indices would not improve overall reliability. All of the skill variables

Table 2. Reliability Analysis of Learner Research Skills			
Research skills variables	**Corrected item–total correlation**	**Alpha if item deleted**	**Cronbach alpha**
Presurvey			.97
Understand marine science concepts	.55	.97	
Make use of the primary scientific research literature	.77	.97	
Identify a specific question for investigation using research	.87	.96	
Formulate a research hypothesis	.84	.96	
Design an experiment or theoretical test of the hypothesis	.86	.96	
Understand the importance of "controls" in research	.84	.96	
Observe data	.81	.97	
Collect data	.83	.97	
Statistically analyze data	.74	.97	
Interpret data by relating results to the original hypothesis	.85	.96	
Reformulate your original research hypothesis	.92	.96	
Relate results to the "bigger picture" in marine science	.85	.96	
Orally communicate the results of research projects	.80	.97	
Write a research paper for publication	.84	.96	
Think independently	.72	.97	
Postsurvey			.95
Understand marine science concepts	.58	.95	
Make use of the primary scientific research literature	.67	.94	
Identify a specific question for investigation using research	.79	.94	
Formulate a research hypothesis	.83	.94	
Design an experiment or theoretical test of the hypothesis	.76	.94	
Understand the importance of "controls" in research	.73	.94	
Observe data	.76	.94	
Collect data	.72	.94	
Statistically analyze data	.72	.94	
Interpret data by relating results to the original hypothesis	.81	.94	
Reformulate your original research hypothesis	.81	.94	
Relate results to the "bigger picture" in marine science	.70	.94	
Orally communicate the results of research projects	.62	.95	
Write a research paper for publication	.66	.95	
Think independently	.66	.94	

within each survey were thus combined and computed into two mean composite indices (i.e., presurvey, postsurvey). A Wilcoxon test of the two indices showed a significant increase in overall self-perceived research skill capabilities from the pre- to postsurvey ($p = .004$), with a minimal to typical effect size (Table 1).

Qualitative findings further supported these measured changes. For example, several learners emphasized their increased ability to communicate research both orally and in writing. One learner wrote that COESSING taught them "how to take data and make a presentation on the data I have analyzed and worked on" (postsurvey). Another research skill influenced by participation in COESSING 2018 resulted from the perceived opportunity to learn about "software used for conducting marine scientific research" (Table 6). Across the post- and post-post-surveys, 35 learners indicated they learned to use software commonly used for conducting oceanographic research, with 21 respondents indicating they learned an open-source software and 14 indicating they learned a commercial software. The extent of software skill acquisition was not measured, but exposure to new software had perceived impacts on the learners. As one learner reflected, "COESSING has helped to encourage and further motivate me to continue in my chosen career path by exposing me to softwares that make analysis simple" (postsurvey).

Learners also felt their problem-solving skills were impacted by participating in the summer school. For example, one learner commented that COESSING "showed me to a good extent the practical ways of solving scientific problems" (post-post-survey). The learner-identified increases in problem-solving abilities could have resulted from the hands-on components of the program, where learners can work through problems together as well as observe how instructors work through problems. That exposure to different ways of thinking potentially enhances learner abilities to solve problems. For example, a learner wrote in an email to an instructor after the program:

> I have really learnt a lot from you and you have really inspired me from how you handled the projects, even though you did not have all the solutions for the [software] problems you just kept on working, learning more and solving one problem at a time and that has really inspired me. (Field notes)

The perceived improvement and diversification of problem-solving techniques suggests the importance of the hands-on lab and project opportunities provided by COESSING.

Attitudes toward marine science. The presurvey means for learner attitudes about marine science were consistently closer to the more positive word on the semantic differential scales (Table 3). The postsurvey means showed slight increases across all five variables, suggesting slightly more positive attitudes toward marine science

Table 3. Wilcoxon Signed Rank Analysis of Pre- and Postsurvey Learner Attitudes About Marine Science

Attitude variables	Presurvey		Postsurvey		Wilcoxon-test value	*p*-value	Cohen's *d*
	M	*SD*	*M*	*SD*			
Dislike–Like	4.49	0.71	4.61	0.61	1.26	.206	.18
Bad–Good	4.61	0.61	4.65	0.56	0.44	.660	.07
Negative–Positive	4.52	0.68	4.56	0.62	0.41	.685	.06
Boring–Interesting	4.55	0.68	4.59	0.76	0.28	.781	.06
Harmful–Beneficial	4.67	0.51	4.73	0.49	0.62	.536	.11
Overall[a]	4.55	0.62	4.60	0.55	0.80	.427	.09

Note. Variables are measured on a 5-point semantic differential scale, where 1 = *most negative* and 5 = *most positive*.
[a] Excludes "Harmful–Beneficial" due to poor reliability.

after participating in the program. However, these increases were not statistically significant based on the Wilcoxon tests.

Cronbach's alpha reliability analyses of the variables for both the pre- and postsurvey attitudes revealed coefficients above .65 (Table 4). Deletion of the "harmful–beneficial" variable resulted in higher reliability, so this was removed from the analyses. The remaining four variables were combined and computed into two mean composite indices (i.e., presurvey, postsurvey). A Wilcoxon test of the two indices showed that, similar to the individual variables, the slight increase observed in overall attitude (ΔM = 0.05) was not significant (p = .427; Table 3).

Although general attitudes toward science did not significantly change, qualitative data suggest that more specific attitude change may have occurred among some learners. For example, one learner wrote:

> I really did not like chemistry from high school because it looked so abstract, but through COESSING I got to understand chemistry is the very existence of nature and the world has developed this far partly because of chemistry. That was great. (Postsurvey)

Another learner reflected, "COESSING has changed my view and way of thinking in a way as to go beyond the physical observation to 'application of softwares and models'" (postsurvey). These positive changes in attitudes toward chemistry and modeling reflected the attitude change that some learners experienced toward specific scientific topics.

Beliefs about science careers. Presurvey learner beliefs about scientists and science careers revealed a large range of means, with high standard deviations (Table 5). The range of postsurvey means was similarly large, and the spread of the means widened. Seven of the variable means increased from pre- to postsurvey, two decreased, and one remained the same. However, results from Wilcoxon tests revealed that the observed decrease in means for "Scientists do NOT have enough time for their families" was the only significant difference (ΔM = –0.67, p = .010), with a minimal to typical effect size. Cronbach's alpha reliability analyses of the belief variables revealed low alpha reliability coefficients of .50 for the presurvey and .32 for the postsurvey. Thus, overall indices were not calculated because belief variables were not measuring the same concept (Cortina, 1993).

Furthermore, how learners wrote about their intention to pursue a science career did not vary greatly over time. The explanations for career intentions likely reflect learner general beliefs about science careers. Learners most often identified the applicability of science to solving problems as why

Table 4. Reliability Analysis of Learner Attitudes About Marine Science			
Attitude variables	Corrected item–total correlation	Alpha if item deleted	Cronbach alpha
Presurvey			.94
Dislike–Like	.86	.92	
Bad–Good	.85	.92	
Negative–Positive	.89	.91	
Boring–Interesting	.81	.93	
Postsurvey			.88
Dislike–Like	.72	.85	
Bad–Good	.80	.83	
Negative–Positive	.77	.83	
Boring–Interesting	.71	.87	

Note. Indices exclude "Harmful–Beneficial" variable.

Table 5. Wilcoxon Signed Rank Analysis of Pre– and Postsurvey Learner Beliefs About Scientists and Science Careers

Belief variables	Presurvey		Postsurvey		Wilcoxon– test value	*p*–value	Cohen's *d*
	M	*SD*	*M*	*SD*			
There is NO need for science in most of today's jobs[a]	6.67	1.04	6.75	0.93	0.55	.581	.08
Scientists work together to solve problems	6.46	1.21	6.46	1.42	0.12	.905	0
A career in science is NOT interesting to me [a]	6.42	1.40	6.46	1.34	0.60	.550	.03
A career in science will support me	6.28	1.34	6.24	1.55	0.20	.986	.03
Scientists help their local community	6.27	1.12	6.49	1.05	1.33	.182	.20
Only the smartest students can have a career in science	2.17	1.57	2.33	1.72	0.50	.620	.10
A career in science means having to work in a laboratory	2.51	1.95	2.90	2.11	1.33	.183	.19
It is important to know science to get a good job	2.51	1.62	2.98	2.04	1.44	.150	.26
Scientists do NOT have enough time for their families [a]	5.75	1.63	5.08	2.03	2.57	.010	.36
A career in science would be fun	6.10	1.36	6.24	1.01	0.37	.715	.12

Note. Variables are measured on a 7–point scale of 1 = *strongly disagree* to 7 = *strongly agree*. Shaded variables are significant at *p* < .05.
[a] Reverse coded.

they wanted to pursue a career in science. Career intention explanations such as "to contribute my quota to my community and the world through solving pertinent issues" (presurvey) and "because I see science as the practical solution to most of the problems holding down the under-developing nations" (post-post-survey) were common across all three surveys. Thus, the widely held learner belief that scientific careers will benefit society was seemingly not affected by participation in COESSING 2018. Other reasons that remained constant before and after participation included the opportunity to learn and discover new ideas, a passion for or love of science, an interest in science, an enjoyment of scientific work, and an uncertainty about the financial stability of science. Two new beliefs emerged postparticipation in COESSING 2018: the diversity of career opportunities and the difficulty of science. The new belief that there are many options in science careers is a favorable belief change, whereas believing science careers are too difficult represents an unfavorable belief change. The one learner who commented that a science career "seems a bit difficult for me" also changed their career intention from "yes" on the presurvey to "unsure" on the post- and post-post-surveys. Thus, COESSING participation largely seems to have had no perceived effect on learner beliefs about science careers, with a few exceptions.

Content knowledge. Mean values of the 12 variables assessing perceptions about learning expectations during COESSING (i.e., presurvey) ranged from moderately to strongly agree (Table 6). Learner per-

Table 6. Wilcoxon Signed Rank Analysis of Pre– and Postsurvey Learner Expectations About Learning Outcomes							
	Presurvey		Postsurvey				
Learn variables	*M*	*SD*	*M*	*SD*	Wilcoxon–test value	*p*–value	Cohen's *d*
General marine science concepts from introductory lectures	6.06	1.14	6.33	1.13	1.12	.242	.24
General marine science concepts from introductory labs	5.82	1.61	6.22	1.27	1.31	.191	.28
Specific marine science concepts from intermediate lectures	5.94	1.38	6.26	1.03	1.28	.200	.26
Specific marine science concepts from intermediate labs	5.74	1.50	6.26	0.94	2.06	.039	.42
The technology used for conducting marine scientific research	6.12	1.13	6.35	1.16	1.18	.239	.20
The software used for conducting marine scientific research	6.02	1.30	6.49	1.17	2.15	.032	.38
Academic opportunities in West African countries	6.14	1.24	5.29	1.76	2.85	.004	.56
Academic opportunities in countries outside of West Africa	6.22	1.16	5.53	1.77	2.44	.015	.46
Tools that can be used in my own research	6.21	0.96	6.42	1.09	1.27	.203	.20
The applicability of science to my current or future career	6.35	0.99	6.54	0.83	0.89	.375	.21
Career opportunities in West African countries	6.17	1.17	5.29	1.60	3.01	.003	.63
Career opportunities outside of West Africa	6.19	1.15	5.51	1.63	2.20	.028	.48
Overall	6.09	0.98	6.06	0.93	0.57	.566	.03

Note. Variables are measured on a 7–point scale of 1 = *strongly disagree* to 7 = *strongly agree*. Shaded variables are significant at *p < .05.*

ceptions about what they learned during COESSING (i.e., postsurvey) had a slightly larger range of means. Eight of the learning variables saw an increase in mean values between pre– and postsurveys of at least 0.19, with the highest observed increase in "specific marine science concepts from intermediate labs" (*ΔM* = 0.52). The remaining four variables decreased in mean value, with changes between −0.68 and −0.88, with the greatest observed decrease in "career opportunities in West African countries" (*ΔM* = −0.88). Wilcoxon tests showed that only two of the observed increases were significant (*p*–values between .032 and .039), with minimal to typical effect sizes, whereas the four observed decreases were all significant (*p*–values between .003 and .028), with

typical to substantial effect sizes.

Results from Cronbach's alpha reliability analyses justified computing two mean composite indices from the 12 learning variables, and removing any items from their respective indices did not improve overall reliability (Table 7). However, a Wilcoxon test of the pre- and postsurvey overall learning indices showed that the slight de-

Table 7. Reliability Analysis of Learner Expectations About Learning Outcomes

Learn variables	Corrected item–total correlation	Alpha if item deleted	Cronbach alpha
Presurvey			.97
General marine science concepts from introductory lectures.	.77	.97	
General marine science concepts from introductory labs.	.74	.97	
Specific marine science concepts from intermediate lectures.	.75	.97	
Specific marine science concepts from intermediate labs.	.74	.97	
The technology used for conducting marine scientific research.	.90	.96	
The software used for conducting marine scientific research.	.91	.96	
Academic opportunities in West African countries.	.86	.96	
Academic opportunities in countries outside of West Africa.	.89	.96	
Tools that can be used in my own research.	.91	.96	
The applicability of science to my current or future career.	.88	.96	
Career opportunities in West African countries.	.82	.96	
Career opportunities outside of West Africa.	.89	.96	
Postsurvey			.89
General marine science concepts from introductory lectures.	.71	.86	
General marine science concepts from introductory labs.	.63	.89	
Specific marine science concepts from intermediate lectures.	.57	.76	
Specific marine science concepts from intermediate labs.	.42	.78	
The technology used for conducting marine scientific research.	.54	.84	
The software used for conducting marine scientific research.	.52	.81	
Academic opportunities in West African countries.	.69	.80	
Academic opportunities in countries outside of West Africa.	.62	.78	
Tools that can be used in my own research.	.58	.63	
The applicability of science to my current or future career.	.57	.66	
Career opportunities in West African countries.	.71	.72	
Career opportunities outside of West Africa.	.70	.64	

crease observed in the means ($\Delta M = -0.03$) was not statistically significant ($p = .566$; Table 6).

Although the extent of specific content knowledge acquisition was not measured, many learners mentioned learning about marine science–related topics through their participation in COESSING 2018. Learners documented their learning of specific topics 61 times, with topics including mining and geochemistry, ecology and fisheries, satellite oceanography, biogeochemistry, and chemistry. Learners also mentioned general ocean science knowledge acquisition 30 times. For example, one learner commented on the postsurvey, "This has strongly deepened my knowledge and understanding about the marine [environment] and the seas."

Another indication of scientific content knowledge acquisition is the perceived influence on individual research projects. For example, one repeat learner wrote during the task-based focus group, "The knowledge I gained from last year's summer school on oil and gas lectures helped me build more ideas about my MSc." Another repeat learner revealed, "The school influenced my choice of project topic for my undergraduate research project" (task-based focus group). The influence of participation on outside research project topics, therefore, suggests that some content knowledge acquisition occurred.

Knowledge of career and academic opportunities in science is another important component of building individual capacity for scientific research (Kennedy & Odell, 2014). The extent of learner perceived changes in knowledge of scientific opportunities, however, was unclear. Even though measured learner expectations were not met, learners still "slightly" to "moderately" agreed that they learned about academic and career opportunities (Table 6). However, this result needs to be viewed in light of an unplanned schedule change that resulted in the postsurvey being administered prior to the presentation on graduate school opportunities, and post–post-survey qualitative data suggested that a few learners increased their knowledge of scientific opportunities. As one learner commented, "COESSING revealed so many opportunities in science apart from the basic ones [I] am aware of." Hence, a knowledge increase of scientific opportunities is a perceived result of COESSING for some learners.

Conceptual knowledge. In addition to the perceived content knowledge acquisition, learner responses indicated a perceived increase in conceptual knowledge. Several learners felt they became more aware of connections between humans and their natural environment. As one learner wrote, "I was able to realize how anthropogenic activities over time affect the environment" (postsurvey). Learners also documented an increased knowledge of the importance of different scientific disciplines in understanding the ocean. One learner reflected, "COESSING has made me understand that satellite imagery together with our normal in situ data collection can really help us achieve and make better decisions, especially in fisheries and water management" (postsurvey). The comment that "now [I am] able to better appreciate other disciplines like mathematics in the learning of the ocean" (task-based focus group) suggested longer term impacts of COESSING on learner conceptual understanding of the marine sciences. Other learners reflected on how their overall conceptualization of marine sciences changed. For example, one repeat learner wrote, "The summer school gave me a different dimension in understanding oceanography outside the university classroom" (task-based focus group). The perceived improvements in learner conceptual understandings of human–environment interactions, interdisciplinary research, and marine science indicated that conceptual knowledge acquisition occurred for some learners.

Connections with people. During COESSING, learners interacted with each other, Ghanaian instructors, and international instructors. Learner perceptions about interaction opportunities they expected to have during COESSING (i.e., presurvey) were relatively consistent across the 10 variables (Table 8). On the other hand, learner perceptions of the opportunities they had during COESSING (i.e., postsurvey) were more varied. Four of the variable means had observed increases, whereas the remaining six had observed decreases. Wilcoxon tests revealed that "participate in hands-on labs" was the only significant observed increase ($p = .024$), with a minimal to typical effect size. Five of the observed decreases were significant (p-values between .002 and <.001), with typical to substantial effect sizes. The expectation to "form research partnerships with Ghanaian professors" had by far the largest observed negative change

Table 8. Wilcoxon Signed Rank Analysis of Pre– and Postsurvey Learner Expectations About Opportunities

Opportunity variables	Presurvey		Postsurvey		Wilcoxon– test value	*p*–value	Cohen's *d*
	M	*SD*	*M*	*SD*			
Participate in hands–on labs	6.00	1.13	6.51	1.21	2.25	.024	.44
Network with university students from across West Africa	6.25	0.90	6.34	1.26	1.25	.211	.08
Network with Ghanaian professors	6.32	0.89	5.40	1.68	3.42	.001	.68
Network with international professors	6.33	0.90	6.25	1.27	0.26	.799	.07
Socialize with university students from across West Africa	6.26	0.90	6.45	1.01	1.26	.209	.20
Socialize with Ghanaian professors	6.26	0.94	5.55	1.60	3.04	.002	.54
Socialize with international professors	6.26	0.92	6.34	1.04	0.27	.785	.08
Form research partnerships with university students from across West Africa	6.30	0.87	5.36	1.82	3.10	.002	.67
Form research partnerships with Ghanaian professors	6.28	0.90	4.64	2.10	4.12	<.001	1.02
Form research partnerships with international professors	6.29	0.92	4.98	2.06	3.42	.001	.82
Overall [a]	6.29	0.84	5.71	1.16	2.88	.004	.57

Note. Variables are measured on a 7–point scale of 1 = *strongly disagree* to 7 = *strongly agree.* Shaded variables are significant at *p* < .05.
[a] Excludes "Participate in hands–on labs" due to poor reliability.

(ΔM = –1.64, *p* < .001) with a substantial effect size.

Cronbach's alpha reliability analyses of the 10 variables for the pre– and postsurvey opportunity statements showed alpha reliability coefficients above .65 (Table 9). However, coefficients increased when the "participate in hands–on labs" variable was removed, so it was not included in the final indices. The remaining nine variables within each survey were combined and computed into two new mean composite indices (i.e., presurvey, postsurvey). Results from a Wilcoxon test of the two overall opportunity indices showed that the observed decrease in means (ΔM = –0.58) was significant (*p* = .004), with a typical to substantial effect size (Table 8).

Overall, learners felt they had more opportunity to interact with other West African learners than they had expected. Learner expectations about interacting with Ghanaian instructors were not met, whereas expectations about interacting with international instructors were generally met. The quantitative data, however, did not indicate the value of each interaction. Qualitative results suggest positively perceived impacts and outcomes from interactions experienced among the three groups. The types of interactions that occurred were categorized into three levels—social, networking, and

Table 9. Reliability Analysis of Learner Expectations About Opportunities			
Opportunity variables	Corrected item–total correlation	Alpha if item deleted	Cronbach alpha
Presurvey			.99
Network with university students from across West Africa	.95	.99	
Network with Ghanaian professors	.96	.99	
Network with international professors	.95	.99	
Socialize with university students from across West Africa	.94	.99	
Socialize with Ghanaian professors	.92	.99	
Socialize with international professors	.95	.99	
Form research partnerships with university students from across West Africa	.96	.99	
Form research partnerships with Ghanaian professors	.95	.99	
Form research partnerships with international professors	.93	.99	
Postsurvey			.88
Network with university students from across West Africa	.66	.87	
Network with Ghanaian professors	.72	.86	
Network with international professors	.55	.88	
Socialize with university students from across West Africa	.60	.88	
Socialize with Ghanaian professors	.66	.87	
Socialize with international professors	.61	.87	
Form research partnerships with university students from across West Africa	.64	.87	
Form research partnerships with Ghanaian professors	.77	.86	
Form research partnerships with international professors	.66	.87	

Note. Indices exclude "Participate in hands-on labs" variable.

research partnership forming—with different perceived impacts experienced at each level.

At the basic, social level of interaction, learners "slightly" to "strongly" agreed that they had the opportunity to socialize with one another and the instructors (Table 8). The perceived impacts of the social opportunities of COESSING include increased cross-cultural understanding and stronger social skills. For example, one learner identified the "cultural diversity encountered" as their longer term impact of participation (post-post-survey). In terms of social skills,

a self-identified "quiet" repeat learner perceived her participation in COESSING as allowing her to "now [be] able to open up to others with ease and make friends" (task-based focus group). Another repeat learner explained that their approach to socializing was affected: "I now see conversations with other people as an opportunity to share knowledge as I got to learn a lot from other participants in last year's summer school" (task-based focus group). The opportunity to casually socialize with colleagues and instructors thus appears to have been an impactful component of the summer school.

Learners "slightly" to "strongly" agreed they had the opportunity to network during COESSING 2018 (Table 8). Many learners mentioned again in their open-ended responses the opportunity to network with their fellow learners. As one learner emphasized, networking "with colleagues across West Africa . . . is a rare opportunity!" (post-post-survey). One of the small groups of repeat learners in the task-based focus group even ranked the academic connections made among learners as the most important long-term impact of their participation. Thus, COESSING provided a needed platform to facilitate professional connections among the West African learners. Learners also perceived outcomes from their networking opportunities with the instructors. One learner commented that networking with the instructors "motivated [them] to aspire" (post). One of the female instructors also shared that a female learner studying physics at the graduate level was struggling as a female in physics (interview). The learner indicated that the instructor's professional interactions provided a role model, potentially reassuring her that women can succeed in physics.

Learners felt they had fewer opportunities to form research partnerships than expected. Survey results showed learners were between "neither" agreeing nor disagreeing and "moderately" agreeing they had the opportunity to form any research partnerships, albeit with low consensus (Table 8). Similarly, several instructors observed that they did not maintain contact with any of the learners following previous COESSING programs (interviews). Some learners, however, did form research partnerships. A few learners mentioned building research partnerships in general, with comments such as "I had the opportunity of meeting Ghanaian teachers and students who are willing to help me in my final year research work" (postsurvey). Other learners acknowledged specific instructors with whom they collaborated or are planning to collaborate in the future. A substantial research partnership was formed between an early-career Ghanaian instructor and a late-career American instructor (field notes). In this outlier example, the Ghanaian instructor is now a master's student working with the American instructor in the United States. Thus, at this stage, COESSING's facilitation of research partnership formation is relatively low, with minimal perceived impacts on learners.

Instructors

The impacts of participating in COESSING identified by instructors can be divided into three categories: professional development, cultural exchange, and advancing the field (see Appendix A for a definition of each theme). The method of data collection for provided evidence was the interviews, unless indicated otherwise parenthetically.

Professional development. Only four of the 18 instructors discussed their perceived professional development from participating in COESSING. Three American instructors (two early-career, one late-career) mentioned the opportunity to improve teaching skills. One of the early-career Americans also indicated that COESSING provided them with the opportunity to work on their leadership skills. The three American instructors who identified professional development impacts from COESSING did not discuss their experiences in detail. For example, one instructor simply stated, "I've been wanting to work on teaching and communicating science, and this was an opportunity for me to get to work on that," without elaborating further. On the other hand, one of the early-career Ghanaian instructors discussed in detail how their career advanced. The instructor discovered a new "niche between profession and academia itself" and is now pursuing another postgraduate degree internationally in that "niche" field because of their participation in COESSING. Thus, although some of the instructors experienced professional development, it does not appear to have been perceived as a primary impact of participation.

Discussion around why instructors chose to participate in COESSING suggested an explanation for why they may not have been perceiving professional development impacts. Qualitative data indicated consensus among the instructors that COESSING is an opportunity for them to "give back" to their communities and that "everyone is volunteering their time" (field notes). For example, one of the late-career Americans identified the "appealing" aspect of COESSING as "the potential for me to get involved in a program where we actually go and make meaningful impactful change in the lives of folks." Similarly, a late-career Ghanaian instructor explained their motivation for participating as "helping to develop the next crops of scientists in oceanography and fishery." Hence, the instructors appeared to primarily frame COESSING as

altruistic volunteerism instead of as part of their own career development. Another late-career American instructor even commented, "It's good broader outreach. But that's not really why I do it because I could do other things with that time." Regarding COESSING as a form of volunteerism could hinder instructors from identifying the potential professional development impacts.

Cultural exchange. The majority of instructors identified cross-cultural exchange and awareness as an outcome of their participation in COESSING. Many of the instructors highlighted the opportunity to see how scientists from different cultures and backgrounds conducted their science. For example, an early-career American reflected, "I don't know if it helped my science, but just seeing how things are done differently I think is helpful to me too." The Ghanaian instructors similarly perceived impacts stemming from the cultural diversity of COESSING. As a mid-career Ghanaian observed:

> People are learning, and we are also learning from them because of course I am in Ghana. I've been to Senegal, I've been to Nigeria, I've done research in those countries, but of course I'm not abreast with their system like I am here in Ghana. So, I teach you, you learn from me, I also learn from you.

This Ghanaian instructor thus perceived that their overall knowledge increased because of exposure to how science is conducted in different countries. A mid-career American instructor suggested a potential longer term impact of the cultural exchange offered by COESSING:

> I think this school will increase the ability of Africans to do oceanography, but it also increases the network of US and European scientists that are aware of conditions in Africa and are maybe willing to collaborate with them knowingly, with realistic expectations with what kind of African resources are available here.

The American instructor, therefore, believed that the widely perceived increase in understanding of science in different contexts could encourage other researchers to be more open to international collaborations.

Advancing the field. A third cross-cutting theme related to the idea of "advancing the field," or progressing their field of science. Specifically, five instructors observed that the global nature of oceanography should mandate a global workforce of oceanographers. For example, one early-career American instructor felt that it was "really important" for marine science to be more global in nature because "we all have oceans." A late-career American further reflected:

> I really do feel strongly that we need to do a better job of involving, in whatever form is appropriate, scientists on the African continent if we're really going to say that we study the global ocean. I mean it just seems so silly that we would not involve an entire continent in our work.

Thus, some of the instructors perceived their participation as potentially increasing and diversifying the global oceanography workforce. A diversified workforce will, in turn, advance the field of oceanography because people from different backgrounds conceptualize ideas differently, encouraging different types of questions being asked and different connections being made (Kaplan, 2015).

Discussion

Implications for Higher Education ISLP Design

The perceived impacts of the learners and instructors in the COESSING case study exploration have many implications, discussed below, for designing future higher education ISLPs.

Incorporating Hands-On Learning to Build Confidence in Research Skills

The research skill, content knowledge, and conceptual knowledge acquisition identified by the learners are already understood to be important components of a successful ISLP (National Research Council, 2009). Their presence in COESSING, however, indicated that even programs developed and taught by career scientists can achieve curricular learning outcomes. Moreover, since learner confidence in their ability to conduct research is a "critical" component of future scientific research career success

(Stajkovic, 2006, p. 1209), the increased confidence in research skills immediately following COESSING suggests that the program has been making progress toward its goal of increasing the quantity and quality of West African scientists. Learner emphasis on the hands-on learning opportunities offered during COESSING through the labs and projects reinforced the value of hands-on learning for higher education (Ma & Nickerson, 2006). The findings further suggested the potential significance of more process-focused, experiential learning opportunities for the development of problem-solving skills in adults (A. Y. Kolb & Kolb, 2005; D. A. Kolb, 1984).

Creating Space for Connections Among Participants

Learner emphasis on forming connections with other participants (both learners and instructors) indicated that having the opportunity to meet and interact with other people in their field has been a valuable outcome of COESSING. This perceived value is reflected in the capacity development literature, which identified the importance of both scientist networks and the relationship between established and aspiring scientists in determining research success (e.g., Pillai et al., 2018; Sachatello-Sawyer & Burton, 2002; Strigl, 2003). Learners particularly identified the value of connecting with other West African university students and early-career scientists, indicating the importance of the peer-to-peer contacts formed during ISLPs. On the other hand, learner identification of positive impacts from interacting with instructors reinforced the importance of forming connections with facilitators for adult learners (Sachatello-Sawyer & Burton, 2002).

The connections identified and observed within the proposed three-tiered system—socializing, networking, and research partnership forming—had different perceived impacts experienced at each level. Positive outcomes from socializing indicated that this common, base-level interaction is still valuable and should be considered in designing future higher education ISLPs. Networking, which was also commonly identified and observed, often occurred during the labs and projects where professional discussions were already occurring. The rarity of forming research partnerships (i.e., measured expectations on research partnership forming were not met and were not qualitatively identified), on the other hand, demonstrated the need for a more research-focused program design with more collaborative projects to facilitate future partnerships.

Both learners and instructors identified and valued the cross-cultural interactions they experienced during COESSING. Instructors specifically credited the program's international nature with increasing their understanding of how to conduct science and potentially increasing their willingness to collaborate internationally. For all participants, the opportunity to be exposed to new ways of thinking could ultimately affect how they approach their future scientific research (Kaplan, 2015). Having a diversity of participants in higher education ISLPs can thus offer another dimension of research capacity development.

Valuing Scientist Instructors' Participation

Instructors' not identifying professional development as an important impact also has implications for future higher education ISLP design. Instructors essentially discussed COESSING in much the same altruistic way as volunteers discuss their volunteerism (e.g., Burns et al., 2006; Carpenter & Myers, 2010), indicating that the instructors saw their participation primarily as service, and not as an opportunity for career development. Scientists' not valuing their broader outreach activities as an avenue for professional development is likely linked to this type of work not being prioritized by the academic community. For U.S. instructors in particular, broader outreach has long been relegated to service and is not valued much in the current publication-driven university system (Boyer, 1996). A 2017 National Alliance for Broader Impacts (NABI) forum with 120 participants from U.S.-based institutions found that most scientists felt "academic culture does not reward" their participation in broader impact activities (NABI, 2018, p. 4). Thus, despite the societal and funder-driven push for scientists to engage more in broader outreach activities, the current structure of academia does not provide much professional reward or recognition for this kind of work.

The disconnect between outreach and science likely hinders the ability of higher education ISLPs to recruit and retain scientist instructors. Prior research has shown that scientists prioritize their more clearly required responsibilities of teaching at

their home institution, conducting their own research, and procuring funding for their own research (Andrews et al., 2005). Thus, to encourage this change in instructor perceptions, future program designs should explicitly identify the potential professional development impacts for instructors. On a larger scale, however, there is still a need for the broader scientific community to more formally value this type of work, perhaps as a criterion for hiring and promotion or as its own form of scholarship (Andrews et al., 2005; Boyer, 1996; Johnson et al., 2014; NABI, 2018).

Reflections on Null Results and the Positive Bias

The lack of statistically significant changes in learner attitudes toward marine science and beliefs about science careers was not expected (Osborne et al., 2003). However, as a free-choice learning program dealing with advanced scientific concepts, it is likely that the program attracted only learners who already had positive attitudes toward marine science and favorable beliefs about science careers. This absence of perceived change suggests that changes in attitudes and beliefs may be more difficult to achieve with an audience that is already interested and embedded in the field.

Overall, the overwhelmingly positive qualitative responses provided by the learners likely resulted from a combination of the questionnaire structure and cultural differences. The structure of the qualitative questions on the questionnaire did not readily lend itself to critical answers. For example, on the postsurvey, learners were asked, "What other topics did you learn about during COESSING?" This question does not encourage learners to indicate topics where their learning expectations were not met (i.e., topics they expected to learn about, but did not). Moreover, culturally different understandings of how knowledge sharing relates to respect and politeness may have led the West African learners to not provide negative responses (Boateng & Agyemang, 2015).

Areas for Continued Research

Future research on international collaborative programs should use a team of multicultural data collectors to obtain a more complete picture of the program. During COESSING, learners communicated with one another in a mix of English, French, and various West African languages, which inhibited the monolingual primary researcher's ability to be a full participatory observer. Similarly, although all learners were fluent in English, the socioculturally relevant nature of language may have led to misinterpretations of meaning by both the learners and the researcher during conversations and on the questionnaires (Adika, 2012). Time was another limitation, because only the primary researcher engaged in data collection. Thus, not all aspects of the school were observed due to the interview schedule and the program's two-track design, which limited the representativeness of the field notes. Employing a team of data collection personnel who are representative of the diversity of program participants could overcome these limitations in future research.

Continued research on instructor impacts from participation in higher education ISLPs is needed. The initial design of this study focused primarily on understanding learner impacts. Thus, the instructor interview question guide focused on instructor perceptions of learner impacts and on the program structure in general. Quantitative data were also not collected from instructors. However, it is important to understand instructor impacts so that programs can be designed with instructor recruitment and retention in mind (Andrews et al., 2005).

Additional research should also explore and assess the longer term impacts of programs on their participants, especially since research has shown that learner outcomes can grow and change over time (Sachatello-Sawyer & Burton, 2002). Longitudinal studies with larger samples are also needed to explore how ISLPs are building the capacity for local scientific research in the regions where ISLPs occur. This study largely assessed short-term impacts from participation since data were limited by the small number of learner respondents in the postpost-survey.

Conclusion

As scientists increasingly engage in higher education ISLPs as a form of broader outreach, understanding of how these programs function must also increase to ensure their effectiveness and longevity. The COESSING case study adds to collective understanding by exploring a more complete range of impacts experienced by both learners and

instructors. Findings suggested the need for future program designs to foster a diversity of connections because the range of potential outcomes differed depending on the relationship pairing (learner–learner, learner–instructor, instructor–instructor) and the level of connection (socializing, networking, research partnership forming). Programs should also strive to improve instructor perceptions of how their outreach participation relates to their research and career. Although instructors have positive perceptions of their outreach in general, the lack of direct career connection often relegates outreach to an "important, but . . ." sentiment (Andrews et al., 2005, p. 286). Reconciling the disconnect between the funder-driven push for increased broader outreach activities and the insufficient value attributed to broader outreach participation by the academic community is vital for ensuring the future success of scientist–driven higher education ISLPs.

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Appendix A. Qualitative Codebooks

Table A.1. Categorical Codebook for Qualitative Data			
Code name	Description	Frequency	Example
Background info*	General information about Ghana and the state of its marine resources, management, and research	22	"People believe dilution is the solution to pollution so they take boatloads of trash out and empty it."
Capacity individual	Mentions of individual capacity that do NOT relate to child codes; definitions of capacity building	42	"Being able to provide that link between the great possibilities and what they can really achieve."
Instructor capacity	When instructors discuss building their own capacity, directly or indirectly	27	"I've been wanting to work on teaching and communicating science and this was an opportunity for me to."
Learner capacity	Parent code	0	N/A
Knowledge*	Knowledge or information learned; NOT a tangible skill or ability	164	"Marine biogeochemistry and concepts of tides."
Research partnerships	Building capacity by developing research partnerships; includes ALL mentions of relationships, communicating, networking, and making friends	97	"Get to know people from other countries I can count on if I need data from their country."
Research skills	Learners' perceptions of their ability to conduct research; a tangible skill or ability, NOT just knowledge or information	107	"Python programming language."
Science attitudes	Learner attitudes and beliefs toward science careers	77	"The organism in the ocean are more important and need preserved."
Career intention pre*	Responses to presurvey question: Do you intend to pursue a career in science, why or why not	60	"Because science carries the solution to the world's problem."
Career intention post*	Responses to postsurvey career intention question	78	"Because it seems a bit difficult for me."
Capacity institutional	Mentions of extent of impacts on an institutional/ university level	20	"We have realized that we also have to start oceanography and hydrography course."
Capacity systemic	Mentions of extent of impacts on societal/systemic level	16	"At a higher level, at the society level, we may not see it now."
Methods	Researcher notes about method plan and execution	36	"After lunch I interviewed [name] over in the neighboring courtyard."
Improvements	Researcher notes about what could have gone differently	2	"Recording conversations could have provided interesting data."
Program evaluation	Parent code	0	N/A

*Indicates code was not a part of the initial code book.

Table A.1. Categorical Codebook for Qualitative Data *cont'd*

Code name	Description	Frequency	Example
Instructor expectations	Parent code	0	N/A
Future direction	Instructor expectations for direction program should take in the future	81	"Going forward I am looking forward to a school that is focused."
Instructor pre	Instructor expectations of the program, their role, and what they would take away from it	41	"I expected to interact with undergrads primarily and teach oceanography at the intro level."
Instructor post	How instructor expectations compared to their experiences; outcomes for the program, their role, and themselves	47	"It's really much bigger than I thought it would be initially."
Perceived learner pre	Instructor perceptions of why learners attend the program; NOT instructor expectations for the program structure	21	"They want to learn about what is being done in other countries."
Perceived learner post	Instructor perceptions of what learners are taking away from the program	29	"So I think that it gives them the sense of here's what these people do outside of teaching."
Learner expectations	Parent code	0	N/A
Learner pre	Expectations for the program that do NOT relate to child codes	27	"To enhance my knowledge and build more guile in problem solving."
Learn pre*	Responses to presurvey: what other topics do you expect to learn	65	"Ways by which participants can help protect marine lives in our various countries."
Opportunity pre*	Responses to presurvey: what other opportunities do you expect to have	47	"How to get funding for research."
Learner post	Self-perceived outcomes from attending	22	"How to use Python."
Learner post–post	Self-perceived longer term outcomes/impacts from participating	47	"It has aided my level of thinking and its application to my dissertation."
Researcher observation	Field notes not directly related to the other categories	47	"The instructors rode separate from the participants on the way back because the other buses dropped the participants off at the hostel."

* Indicates code was not a part of the initial code book.

Table A.2. Thematic Codebook for Qualitative Data			
Code name	Description	Frequency	Example
Professional development	Instructor perceptions of increased ability in career–associated skills and general career advancement	5	"I think just from a very basic gain is additional teaching experience."
Cultural exchange	Instructor mentions of their relative understanding of different cultures	11	"We are interacting with people from different countries so we have culture impact."
Altruism	Instructor mentions of "helping" or "volunteering" or other altruistic motivation	14	"That felt like they were going to be meaningful contributions and not charity projects."
Advancing the field	Instructor mentions of perceived and potential progress made in the field of oceanography	18	"It's really important to have international collaborations, we all have oceans."
Research skills	Learner perceptions of their ability to conduct research; ONLY include tangible tasks or skills learned	79	"I learned how to download oceanography data, how to use Python, MatLab to analyze those data."
Attitudes and beliefs	Learner perceptions of marine science, scientists, and science careers	194	"I believe science is very applicable in solving many real life problems."
Content knowledge	Learner perceptions of their basic understanding of scientific information and opportunities	121	"The school influence my choice of project topic for my undergraduate research project."
Conceptual knowledge	Learner perceptions and ability to make connections between ideas and across disciplines	22	"I am now able to better appreciate other disciplines like mathematics in the learning of the ocean."
Connections among people	Parent code	0	N/A
Socialize	Learner mentions of socializing or interacting with other learners or instructors; NOT networking	25	"I was able to make friends which I kept in touch with till this year."
Networking	Learner explicit mentions of "networking" or of implied professional connections with learners or instructors	22	"Got the chance to network with other students from different countries."
Research partnerships	Learner explicit or general mentions of forming research partnerships with learners or instructors	9	"Connecting with [instructor] to work on a project."

The Environment Corps: Combining Classroom Instruction, Service-Learning, and Extension Outreach to Create a New Model of Community Engaged Scholarship at the University of Connecticut

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Abstract

An extensive faculty partnership at the University of Connecticut (UConn) that reaches across college and departmental lines is engaged in a project that seeks to enhance, expand, institutionalize, and study a new model for community engagement. The model, called the Environment Corps (E-Corps), combines the familiar elements of classroom instruction, service-learning, and extension outreach to create a method of engagement that aims to benefit students, faculty, surrounding communities, and the university community itself. This article describes the structure and history of E-Corps; details the institutional setting, faculty partnerships, and pedagogical strategies involved; and discusses early evidence of impacts and future prospects.

Keywords: engagement, environment, community, service-learning

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Project Setting

Institutional Setting: A Rethinking of Public Engagement and a New Focus on the Environment

As the flagship university of the State of Connecticut and a land- and sea-grant university, the University of Connecticut (UConn) strives to meet the challenges set forth to state and land-grant universities in the seminal Kellogg Commission report *Returning to Our Roots: The Engaged Institution* (1999), which states:

It is time to go beyond outreach and service to what the Kellogg Commission defines as "engagement." By engagement, we refer to institutions that have redesigned their teaching, research, and extension and service functions to become even more sympathetically and productively involved with their communities, however community may be defined. (p. 9)

As we move beyond the 20-year anniversary of this report, few institutions would argue that the bar set by the Kellogg Commission has been reached. Whitmer et al. (2010) argued that the enormous potential for academia to assist with the world's complex problems is hindered by widespread, entrenched institutional systems of faculty performance review, reward, and funding. Irwin et al. (2018) echoed these sentiments but also expanded upon them:

New mechanisms, policies and tools . . . are required to bridge the barriers that currently limit the effectiveness of scholars and academic institutions. These bridges should foster deep integration of

disciplines (convergence), and collaboration between academic and non-academic stakeholders (transdisciplinary), that together enable the co-production, communication, and application of knowledge. (p. 325)

In search of these mechanisms, policies, and tools, UConn is in the early stages of reenvisioning its public engagement philosophy and strategy. As part of this effort, the university service-learning program has recently been relocated to the Center for Excellence in Teaching and Learning (CETL). CETL's objectives for their new charge include making service-learning more systematic in training faculty, providing resources, attracting students, and tracking results regarding students and the communities in which they work. This initiative was strengthened even further by a new emphasis at the university on Life Transformative Education, which, among other things, incorporates experiential learning and deeper connections between faculty and students to enable greater impact on students' well-being as they move through life (UConn Life-Transformative EducationTask Force, 2021). Thus, the timing is ideal for programs that help redefine public engagement at the university through the promotion of new service-learning models and the development of support and facilitation mechanisms to ensure their success.

The timing is also excellent for new models of engagement to be focused on the environment. In April 2018, the University Senate approved a general education ("GenEd") requirement for environmental literacy. This new requirement was implemented in fall semester 2019, with the added stipulation that qualifying courses needed to address not just environmental topics but human impacts on the environment. This is reflective of the strong environmental ethic at UConn, which has been ranked in the top 10 "green" schools nationally in the Sierra Club "Cool School" index for 6 of the last 7 years (*Sierra*, 2019). The new GenEd requirement is catalyzing examination of environmental curricula throughout the university and has created a need for sustainable offerings of courses that focus on the environment and result in a new generation of students who will have the background, motivation, and competencies to engage in environment-focused STEM initiatives.

Community Engagement Setting: Addressing the Capacity Gap

Before and during the shifting of these institutional factors at the university, a small team of faculty were developing a new transdisciplinary public engagement/service-learning model. The effort began as a pilot project proposed in 2016 to an internal grant program of the Provost's Office focused on supporting the university's Academic Plan. The team included members from both the Land Grant and Sea Grant arms of the university, programs that have a long history of public and community engagement. The remainder of the team consisted of the directors of the three environmental majors at UConn: Environmental Studies, Environmental Sciences, and Environmental Engineering. The proposal, to develop and conduct a new academic offering called the Climate Corps, was successful in obtaining a modest seed grant for a 3-year period.

In a "big picture" sense, the Climate Corps was a response to the longstanding contention of some faculty members that the land-grant system had room for improvement in assisting communities with non-agricultural land use issues (Arnold, 2000). More immediately, it was in response to two recent studies by team members focused on understanding the scope and nature of local (municipal) needs regarding planning for, and adapting to, climate change. In the first study, Hyde and Barrett (2017) interviewed municipal officials from 20 towns along the Connecticut coast, which was battered by Tropical Storm Irene in 2011 and Superstorm Sandy in 2012. The interviews had two main objectives. First, to identify high priority needs and concerns regarding climate change and resiliency, and second, to determine what standard of authority local officials were willing to accept in the context of incorporating climate information into their local planning and regulatory documents. Interviewees included both elected and appointed officials and were drawn from a range of departments, including public works, engineering, planning and zoning, conservation, emergency management, and health. The responses resulted in a list of about 55 priority informational needs that included a wide range of topics from flood inundation prediction to septic system failures to tax policy.

Boyer (2013) and Boyer et al. (2017) analyzed climate change policy development from all

169 municipalities in the state, creating an extensive quantifiable data set about what towns were doing (or not doing) regarding climate adaptation planning, and what constraints existed on policy action. To explore the motivations for, and constraints on, adaptation policy-making, they collected data through open-ended interviews about policy-makers' perceptions of the successes and failures of adaptation policy-making in their community.

A major finding of both efforts was that for most local officials, overall lack of resources and expertise, rather than lack of interest or desire, were the key elements in the lagging resiliency planning efforts across Connecticut. This is not surprising: As with communities in most areas of the country, Connecticut cities and towns are struggling to marshal sufficient resources to fulfill their responsibilities to their citizens and to state and federal governments. Connecticut does not have county government, and land use plans and policies are determined at the local (municipal) level. Many of the state's 169 municipalities do not have full-time professional staff to handle the assessment, mapping, engineering, and other tasks needed to comply with increasingly complex regulations, take advantage of state/federal governmental resources, or conduct proactive planning. The need for STEM-related skills and competencies is especially critical for tasks and programs related to environmental protection. The need to address this issue, referred to as the "capacity gap" by the team, forged a link between traditional academic and extension faculty on the team and became the focus for the Climate Corps experiment that, in turn, provided the foundation for the Environment Corps.

Environment Corps Overview

Formation and Partners

The Climate Corps is now in its 4th year and has inspired the creation of a second course (Brownfields Corps) and a third (Stormwater Corps), now collectively known as the Environment Corps, or E-Corps. Information on the individual courses is provided in the next section, but all share a common structure: a three-credit course focused on situated and practice-oriented instruction, followed in the next semester by a three-credit independent study/practicum where teams of students work directly with town officials on a range of projects related to the topical theme of the particular course. The instructional model (to date) is that each course has two instructors, with one taking the lead during the classroom semester and one the lead during the practicum semester. The uniqueness of the E-Corps model is not in any one feature, but in the combination of innovative classroom instruction, service-learning, and community engagement supported by extension outreach. In effect, the model extends the land- and sea-grant ethic to the undergraduate student body, a vital and largely untapped source of university engagement with communities.

E-Corps was enabled by the collaboration of faculty across departmental and college lines. The project team includes five academic departments in four colleges/schools at UConn: the College of Agriculture, Health and Natural Resources, the College of Liberal Arts and Sciences, the Neag School of Education, and the School of Engineering. In addition, it includes four university-wide centers: the Center for Land Use Education and Research (CLEAR), the Institute of the Environment, the Connecticut Sea Grant Program, and the Center for Excellence in Teaching and Learning. Finally, it includes all three "environmental" major programs (Environmental Studies, Environmental Sciences, Environmental Engineering), and the Office of the Provost. Consolidation of this partnership, and the resources to add project components focused on research, evaluation, and institutional sustainability, were made possible by funding in 2019 from the Improving Undergraduate STEM Education (IUSE) program of the National Science Foundation (NSF).

Project Structure

E-Corps has three major aspects: instructional, integrational, and research and evaluation (Figure 1). The instructional aspect focuses on the enhancement of the E-Corps model through support and coordination of the three existing courses, as well as the exploration of additional courses. An instruction team was put in place, consisting of the instructors of all three courses and representatives from the Center for Excellence in Teaching and Learning (CETL). The institutional, or integrational, aspect of the project focuses on identifying, fostering, and understanding the institutional changes needed to ensure the long-term success and viability of E-Corps as a new

university public engagement model, set in the context of UConn but relevant to other universities. This aspect of the project is led by faculty from the Office of the Provost and CETL, and also includes the directors of several of the university centers involved. The research and evaluation aspect of the project focuses on investigation into the impact of the model on faculty, students, and administrators, and is led by faculty from the Neag School of Education. In addition, in response to the COVID-19 pandemic, grant resources were shifted to enable a modest parallel research effort that investigated the impact on student learning and instructional strategies of the transition to a virtual learning environment. All aspects of the project engage with the external evaluation team, which works in complementary fashion with the research team to evaluate the effectiveness of the instruction, the appropriateness of the research, and the success of ground-level impacts in Connecticut communities. More detail on each of these project components follows in the rest of the article.

Information on the number of students and projects involved in this effort, from the debut of the Climate Corps in 2017 through spring semester 2021, appears in Table 1. Because of their emphasis on discussion and small-team projects, E-Corps classes are limited to 24–30 students; the practicum semester enrollment is smaller both for practical (not all students enroll in the practicum) and pedagogical (the logistical complications of the practicum demand that only four or five student teams be assembled per semester) reasons. Although E-Corps classes are targeted primarily at the environmental majors, the courses have attracted students from 15 other majors. This includes other STEM majors (e.g., bio-logical sciences, chemical engineering, civil engineering) and non–STEM majors (e.g., economics, English, political science, urban and community studies).

There is no one template for an E-Corps classroom semester course. Each program has evolved in the context of the environmental issue upon which it is focused, and the way in which its instructors interact with communities on these issues. In the case of the Brownfields and Stormwater Corps, these factors were also influenced by the experience of its E-Corps predecessor(s). However, the courses share many common elements. On a conceptual level, these common elements can be captured as *high-leverage practices* and are a major focus of the project's research component. High-leverage practices (HLPs) can be understood as the instructional practices that aim to stimulate advancements in all student thinking, support students' participation in disciplinary pursuits, and be applied frequently across disciplinary topics and subject matter (Windschitl et al., 2009). HLPs are drawn from the field of teacher education and have been recently recognized for how they can support a community in their work of developing, refining, and sharing knowledge about teaching and learning (T. Campbell et al., 2019).

The HLPs for the E-Corps project were developed through the integration of previous literature about teaching and learning and an understanding of the practices already used by UConn E-Corps instructors. These HLPs are situated within community environmental challenges and iteratively negotiated with community members. They involve first (1) eliciting students' initial ideas; then dedicating considerable time to (2) informing approaches to problems by
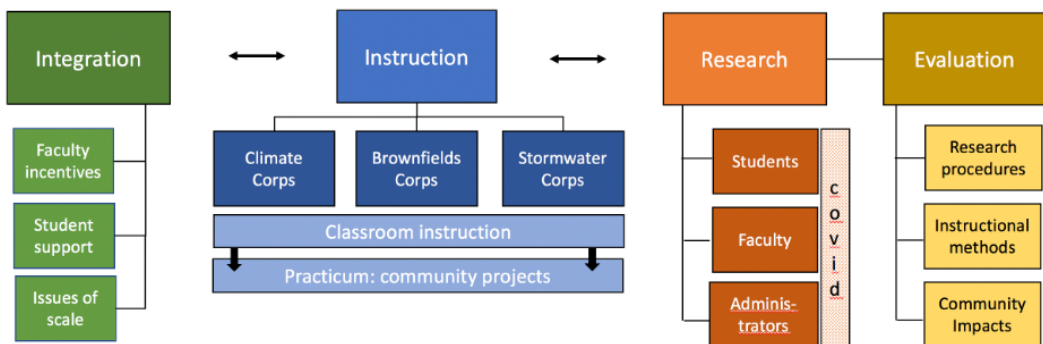

Figure 1. Major Elements of the E-Corps Project

Table 1. Summary Statistics for E–Corps Courses Through Spring 2021	
Total enrollment	281
Classroom students	186
Practicum students	95
Climate Corps students	133
Brownfields Corps students	117
Stormwater Corps students	31
Community projects	76

introducing disciplinary principles, practices, and frameworks; and culminating in (3) developing informed solutions to community problems. The HLPs are described in more detail in the article's Research and Evaluation section.

At the classroom level, the instruction team has compiled a list of instructional techniques that are used by at least two of the three courses:

- Discussion of a hypothetical community scenario both early and late in the semester

- Use of case studies

- Reading assignments using current events/media coverage

- Role-playing exercises

- Guest lectures from real-world practitioners

- In-class small-team exercises

- Small-team assignments/projects

- Field visits

- Critical reflection

- Peer evaluation

In addition, the use of real-world cross-cutting skills and/or competencies is explicitly emphasized. These skills include a working knowledge of the local land use decision-making process; the use of online mapping tools; verbal and written communication related to coordinating with a "client" (town) and relating the results of a project; and teamwork.

E–Corps Courses

Climate Corps

The Climate Corps was planned, developed, and approved during Academic Year (AY) 2016–2017 and debuted during the next AY, in fall 2017. The course Climate Resilience and Adaptation: Municipal Policy and Planning is cross-listed in three colleges/programs at the university. Students taking the class can choose to move on to an independent study in the spring semester, working in teams on climate-related projects with Connecticut towns. This model benefits the students by providing relevant real-world workforce training, benefits the towns by producing usable information/products, and benefits the university by demonstrating the commitment of UConn to the communities of the state. The Climate Corps is cotaught by two Department of Extension faculty: a land use planner who worked in municipal government for several decades as a director of economic development and an ecologist focusing on coastal habitat restoration and management. Both faculty members are involved with regional, state, and local municipal efforts on climate adaptation, resilience, and outreach.

The overall vision for the Climate Corps is for students to develop the ability to assess and analyze how large-scale environmental problems translate to the local level, particularly the world of local land use planning, and for Connecticut towns to gain much-needed assistance in adapting to a changing climate. Learning objectives for students in the class semester include gaining the ability to analyze and assess climate change impacts at a regional, state, and local scale; understand climate policy

and programs at the federal, state, and municipal levels; analyze and assess the relationship of land use to environmental health; conduct a vulnerability assessment through the use of maps, imagery, and land use information; analyze climate-related problems at the local level from interdisciplinary perspectives; and understand how local government functions and the many factors that come into play during the land use decision-making process.

Guest speakers are an important component of this class, with faculty as well as municipal and state officials sharing their experience and efforts with climate change adaptation. Class assignments include reflections based on readings of current newspaper articles, a role-playing exercise, and a cost of sea level rise exercise. In the role-playing exercise, students participate in a mock municipal hearing in a local community grappling with localized flooding due to sea level rise and its impacts on roads, residences, and commercial buildings. Students are randomly assigned roles that include community leaders, residents, climate experts/deniers, and reporters. Student reflections about this exercise include both the difficulty of, and revelations found in, taking on a belief or opinion that they do not personally hold. This exercise also raises awareness of the difficulty in trying to make long-term decisions while elected officials are working on a 2-year or 4-year election cycle.

The cost of sea level rise exercise is a semester-long team project in which students determine primary and secondary impacts of 4 feet of sea level rise to a given section of Miami Beach, Florida. Teams must consider population impacts, costs (including psychological) associated with demolition and relocation, where a new community will be established, what form it will take, and what the flooded Miami Beach waterfront will be used (or not used) for. Although frustrating and confusing at times due to the many decisions that have to be made, students generally feel that they gain a greater understanding of the complexity of climate change impacts and the potential costs to future generations of those decisions or nondecisions.

The second semester independent study focuses on community engagement, in which student teams work with Connecticut municipal and state officials, as well as nongovernmental organizations (NGOs), to conduct climate-related analyses; develop policy, plans, and/or ecological options in response to climate-related problems; and create outreach materials based on the specific needs of the community. From this experience, students gain knowledge of the opportunities for and barriers to climate adaptation at the local level while developing a climate-related report, analysis, or educational product to add to their résumé. Municipalities and NGOs gain much-needed tools and information that assist in their ability to adapt to a changing climate.

Developing a list of potential projects is a critical component of the Climate Corps. Through their extension appointments, the course instructors regularly work with local communities and organizations. Since 2015, they have collaborated on the Climate Adaptation Academy, an iterative series of statewide workshops for local officials and other sectors that explores issues related to local responses to climate change. This allows them to hear and understand local needs, from which independent study projects can be developed. The course instructors play a critical role in the student–community partner interface, helping both to develop realistic expectations for a one-semester project and to ensure that students obtain timely feedback. Because climate change is a socially and politically charged issue, difficulties often arise during the course of these projects. The instructors and students need to be prepared to pivot on projects, and on occasion have had to change course entirely (providing yet another valuable real-life experience for the student teams).

Application of knowledge through the independent study empowers students in moving forward, whether in careers or graduate school, and provides new windows into potential careers. Students have developed products that provide communities with meaningful analyses, reports, and outreach resources; examples of these projects are posted on the Climate Corps website, by year. Communities not only highly value Climate Corps student projects but actually implement and use them. For instance, the Town of Waterford is changing the maintenance regime of a coastal town park based on recommendations from a Climate Corps report, and the City of Norwich is using the data and analyses from a Climate Corps project in their stormwater management program. These documented albeit anec-

dotal impacts will be supplemented in the future with data from the evaluation team's interviews with community representatives, which began in late 2020 (see Research and Evaluation section).

Instructional techniques for the course have evolved over time, as each academic year provides input from formal student evaluations and informal feedback from students, Environment Corps instructor team peers, and pedagogical experts from CETL. Funded by the pilot project grant, a modest formative evaluation was performed for AY 2017–2018, the first year of Climate Corps implementation, by a colleague in the Department of Extension. The study consisted of an online survey of students soliciting feedback on the course semester, the practicum semester, and the overall experience. In addition, phone interviews with town officials from four communities were conducted. The report made recommendations for improvements that primarily focused on earlier communication with town officials in determining the focus of projects; these recommendations were adopted the following AY. The report concluded that the results

> demonstrate that the program has the capacity to grow and evolve, especially with regard to working with municipal partners. However, the students were enthusiastic about the Climate Corps program and found it to be a deeply valuable and useful educational experience, overall. (Kelly, 2018, p. 5)

Brownfields Corps

As the Climate Corps was beginning its second operational year in fall 2018, it was joined by the Brownfields Corps, developed by a member of the original Climate Corps faculty team from the Department of Civil and Environmental Engineering. The fall semester class, Brownfield Redevelopment, is also cross-listed between the three environmental programs and attracts students from diverse disciplines.

The Brownfield Corps is associated with the Connecticut Brownfields Initiative (CBI), a program supported by the State of Connecticut and philanthropic contributions from private sector partners who are actively engaged in brownfield remediation across the state. CBI provides training and techni-

cal assistance to Connecticut communities (including municipalities, regional planning organizations, and nonprofit entities) on several aspects of brownfield redevelopment, such as environmental investigation, remediation, and identification and pursuit of funding opportunities. CBI employs a full-time non-tenure-track faculty member with expertise in remediation who functions both as a liaison to the communities and as coinstructor for the Brownfields Corps, essentially replicating the role of Extension faculty in the Corps model.

Two essential features of CBI support the success of the Brownfields Corps. The first is that CBI serves communities year-round, outside the scope of the course, providing training opportunities to nonstudents, as well as workshops and individual consultation on specific projects. This feature ensures that relationships with communities are ongoing, building trust and creating a steady stream of meaningful projects for students. The second essential feature is CBI's relationships with the state and local industry. These stakeholders benefit from the creation of a skilled workforce and the opportunity to recruit students with knowledge in the field. At the same time, they contribute by providing reliable participation in the course, including student mentoring and consulting on brownfield projects and on issues that require practical knowledge that may be beyond the expertise of UConn faculty.

The Brownfield Corps is structured very similarly to the Climate Corps class, with a two-semester sequence. One difference is that both semesters involve a service-learning component. In the fall semester, students attend lectures provided by a combination of faculty and professionals in the field, on topics ranging from the legal framework and the finances of real estate development to the environmental issues and social aspects of brownfield redevelopment. At the same time, the students work in teams with a Connecticut community on developing a grant proposal to the U.S. Environmental Protection Agency (USEPA) brownfields program. The instructors assemble four-member teams using the CATME tool (Loughry et al.,2014), with an explicit criterion that teams should be interdisciplinary. The grant program has annual deadlines in December, so that proposal submission coincides with the end of the fall semester. The proposal is currently

a 10-page document with the following sections: description of the brownfields and the environmental issues associated with their presence; description of the community itself and the economic, social, and public health impacts of brownfields; and explanation of how the funding will be used to investigate or clean up the sites and the benefits that will arise from these actions. The class includes specific instruction on proposal development throughout the semester, as well as weekly group meetings and periodic meetings with the communities.

There are two final deliverables: a draft of the grant proposal, which is provided to the community, and an oral presentation delivered by each group to the class and a panel of external judges consisting of three professionals. The judges provide feedback in terms of the criteria used by USEPA, and select what they deem to be the most compelling presentation. The winning team has received a small scholarship in the past 2 years, provided by the Brownfields Coalition of the Northeast and CBI. Peer evaluation is also implemented at the end of the semester using CATME and is a portion of the grade. And for partner communities, this aspect of the fall semester has been remarkably successful: In the program's first two academic years, nine proposals were submitted by towns or regional councils of government to the EPA, of which four were funded for a total of $1.1 million.

The learning objectives of the class include technical as well as communication and management skills, and the importance of both is communicated to the students in the syllabus. Technical learning objectives include the ability to identify the status of a site as brownfield; articulate the relevant laws and regulations that govern the management of a brownfield site; describe how public (federal, state, municipal) and private partners are involved in the process of redeveloping brownfield sites; describe the basic concepts of real estate financing; list the different phases of a site investigation, the objectives of each phase, and the methodology to develop a plan for each phase; identify and describe different measures of cleanup and remediation procedures; articulate the elements of urban planning strategies and how brownfields fit into them; identify economic, ecological, and social factors that influence the redevelopment of brownfield sites; and develop commu-

nity engagement plans for the brownfield redevelopment process. Communication and management learning objectives include the ability to explain the elements of a compelling grant proposal; effectively synthesize technical information into a coherent and informative narrative; work together in multidisciplinary teams, meeting deadlines and providing constructive feedback to peers; communicate with government officials in a professional manner; and deliver oral presentations to diverse audiences in a timely and engaging manner.

The spring semester class is identical to the Climate Corps: It takes the form of an independent study (or internship credits depending on the major), with students working on a specific project in teams of two or three. The instructors have found that it is most productive to have larger teams in the fall semester, when students are still on a substantial learning curve, and smaller teams in the spring semester, when students are more experienced and know each other. There are no lectures, and students meet weekly with the instructors to discuss progress and the path forward; thus, a lot of the project work occurs independently. An important component of the spring projects is that the student teams visit the communities, accompanied by the instructors. The personal contact with the stakeholders and the firsthand experience of the brownfield sites and community are critical for project success, both in terms of promoting student understanding of the issues and building rapport between the community and the team.

Several types of projects are supported in the spring semester. These types of projects do not require site access and preclude any kind of exposure of students to contamination. Project types include partial Phase I investigations (background studies of site conditions and potential sources of contamination); preparing scopes of work for Phase II investigations (these are essentially sampling plans that provide communities with an idea of the cost to investigate a site with suspected contamination); brownfield inventories and lists that prioritize brownfields for redevelopment according to various criteria; evaluation of existing data and potential reuse plans for specific sites; and community outreach materials to promote brownfield development and raise awareness in the community.

The CBI team has found that early selection

and communication with the communities is critical to success of the course and the project. CBI issues a request for proposals twice a year, three months prior to the beginning of the semester. The communities are required to submit information on their project and assign a designated contact person. There is often a learning curve on the part of the community itself, as many towns do not have specialized staff or have limited knowledge of brownfield issues. This early communication ensures that the selected projects are appropriate for student work within the confines of a semester and that there is sufficient information available for the project to proceed successfully. Also critical is faculty's refinement of the student work: The instructors frequently spend a considerable amount of time refining and enhancing the student products, especially the grant proposals provided in the first semester. This ensures a consistent quality in the deliverables, again building trust from the community.

Stormwater Corps

A third course is completing its inaugural year in 2020. The Stormwater Corps, which has a "flipped" schedule, with the classroom course in the spring and the practicum in the fall, is led by three instructors, all from the Department of Extension and with a long history of working with communities on stormwater issues. The course, Green Stormwater Infrastructure Practices, is currently listed as a special topics course in the Department of Natural Resources and the Environment, but is seeking colisting in all three environmental majors next year, to join its sister programs. Again, as with the other programs, the Stormwater Corps relies heavily on class exercises, field trips, and practitioner guest speakers to focus on the local aspects of stormwater management. Certain instructional techniques found effective by its two predecessors have been incorporated into the new class. For instance, the instructors have included a role-playing exercise based on the one developed for the Climate Corps.

In the case of the Stormwater Corps, the class curriculum takes direct advantage of the many stormwater-focused projects and tools developed by the instructors in the course of their extension work. For instance, field trips are easily incorporated because the University of Connecticut campus has become a showcase for green stormwater practices (Dietz et al., 2015). Also featured are the smartphone application Rain Garden (Dietz & Dickson, 2013) and an online interactive "story map" detailing the progress of green stormwater implementation throughout Connecticut's towns (Dickson et al., 2018), both developed by the instructors, as well as online mapping sites developed by their colleagues at CLEAR (Rozum et al., 2005).

In fall 2020, independent study students were formed into teams that conducted impervious cover reduction plans for four communities. Each plan is an analysis that has both mapping and field components and is focused on identifying promising opportunities for installing green stormwater practices (also known as Low Impact Development practices). This type of analysis was piloted in summer 2018, via a partnership with Rutgers University and a grant to the team from the nonprofit National Fish and Wildlife Foundation. Such information is in great demand by Connecticut municipalities, most of which are struggling to meet the requirements of a newly strengthened general stormwater permit that began in 2017. As with the Climate and Brownfields Corps, the ongoing relationship of the instructors to the communities is critical, and in this case, the link is particularly robust. The instructors are principals of a longstanding outreach program focused on stormwater management that dates back to the early 1990s (Arnold et al., 2000) and currently lead a 5-year project to assist Connecticut towns with responding to the new stormwater permit.

Research and Evaluation

Research Approach, Questions, and Methods

The research aspect of the project seeks to iteratively refine high-leverage core practices for service-learning and understand how transformative institutional change can be effectively mediated across multiple levels within the university and beyond. Accordingly, we decided on a design-based implementation research (DBIR) methodological approach, which emphasizes systems-level improvement and theory development through design-focused partnerships, typically between researchers and practitioners (Penuel et al., 2011). More specifically, we are using a qualitative case study design (Yin, 2003) as the most ap-

propriate research method. The strength of qualitative methods research lies in its analytical approach, characterized by a coding process that draws simultaneously upon theory and data (Miles & Huberman, 1994). This approach allows the research team to focus on qualitative–naturalistic negotiations and scaffolds that (a) support the development of knowledge about teaching and learning and (b) transform institutions. All human–subjects research conducted as part of the E-Corps project has been approved by UConn's Institutional Review Board.

Specifically, the research focuses on the instructional and institutional or integrational aspects of the E-Corps project (see Figure 1). In relation to the instructional aspects of the project, the research aims to investigate the interactions among the tenets of the high–leverage practices (HLPs) selected to guide this work, the instructors' use of the HLPs (i.e., how they translate into courses and community–based experiences), and the tools that support their use (such as the instructional techniques listed earlier). For each iteration of the E-Corps model, the research team is collecting data that will inform project leaders' decision–making as the model is refined over time. Two questions guide this aspect of the research:

1. What is the nature of instructors' use of the high–leverage practices and the impact on students' service–learning experience?

2. What is the nature of instructors' use of tools, and how does this impact their use of the high–leverage practices?

Further, in relation to the institutional or integrational aspects of the project, the research investigates the process of institutional change needed to support the model, guided by the following questions:

3. How do policies, practices, and incentives (within the University and in the host communities) need to be aligned in order to foster and support the E-Corps model? What factors contribute to successful coordination and realignment?

To answer these questions, data is collected and thematically analyzed (Braun & Clarke, 2006) from interviews with students, instructors, and administrative faculty supporting the program; observations of project team meetings; and collection of project artifacts such as meeting agendas, course syllabi, and instructional rubrics. All interviews and meetings are recorded. Two to three members of the research team (those members involved in data collection) perform the coding and analysis of the data, consulting with other members of the research team to ensure codes and findings related to key concepts of the research questions are representative of data. Specifically, the researchers use a three–step process wherein they create a codebook and establish interrater reliability, discuss disagreements in coding to arrive at a consensus, and code the interviews and observations using the established codebook (Campbell et al., 2013).

High–Leverage Practices

As alluded to earlier, the HLPs represent a conceptual stance or set of principles about how learning and participation can be effectively fostered over time in community–level environmental problem–solving contexts. Table 2 gives a summary of our current version of the HLPs.

As can be seen in Table 2, our HLPs are linked and intricately connected so that the identified real–world scenarios or environmental challenges (e.g., the development of an EPA grant proposal for brownfields cleanup in a Connecticut community) that set the problem space for learning are revisited and refined based on negotiation and engagement with community members, and on what students learn about the real–world scenarios or environmental challenges over time (e.g., relevant science and engineering principles, practices, frameworks, and problem–solving approaches). Through a commitment to focusing on HLPs across the E-Corps courses, a common language and instructor-developed set of instructional techniques connected to supporting learners engaged in the HLPs is being assembled and refined (the current list is included in the previous section) so that a sharable knowledge base about E-Corps teaching and learning embodied in the HLPs will emerge over time.

The project team, like others (e.g., Aleven & Koedinger, 2002; Means & Harris, 2013), recognizes the difficulty that can come from efforts to bring educational innovations to scale. Accordingly, in addition to our study of HLPs, our research also focuses on institutional change, in particular understanding and supporting the interactions and alignment between educational innovation (e.g., E-Corps model) and the policies, people,

Table 2. E-Corps High-Leverage Practices			
Planning the Course	**Identify a community environmental challenge** (stormwater, climate, or brownfield related) that sets the goal or establishes the focal problem (the "Big Idea") for learning and meeting our professional responsibility to the communities that we serve long-term. This focus is identified by faculty in partnership with communities during course development. It provides a real-world context to elicit ideas in the **Initial Phase: Eliciting initial ideas**, a guide for identifying the topics and instructional techniques used in the **Middle Phase: Informing approaches to problems**, and the focus of the development of informed solutions in **Final Phase: Developing informed solutions**.		
Initiating the Course	**Orient** students and the community to the pursuit of E-Corps focused work (e.g., community assessments, grant proposals) at the outset and throughout the course. This orientation entails acknowledging that resolutions will be developed within contexts of uncertainty—important for students entering professions that address environmental community concerns. Help students and communities understand what they will be doing and begin to see HLPs as essential for achieving their identified pursuit. Make it explicit that the pursuit (**the community environmental challenge**) is their important focus that sets the stage for how solutions are proposed (**Eliciting initial ideas**), informed (**Informing approaches to problems**), finalized (**Developing informed solutions**), and continually negotiated with community (**Involvement and interactive negotiation of solutions with community members**).		
Throughout the Course	**Involve and negotiate solutions with community members iteratively**. This process begins early, as instructors work with local stakeholders to identify the community challenge of consequence. It continues through instruction as more information about the local community is shared, such as through in-class guest lectures by community members. Finally, community members are invited to help conceptualize and negotiate developing solutions, particularly as part of the practicum semester. This process becomes iterative as each year's group of student-community collaborative projects adds to the Corps collective experience, shedding more light on the types of outcomes that can be achieved.		
Engaging: High Leverage Practices in the Course	1. **Intial Phase: Eliciting initial ideas** for addressing the community environmental challenge. Ideally, these initial ideas would be captured so that they could be revisited and improved overtime. This will also help students see how their ideas have evolved as connections between their ideas and newly introduced ideas are made as they engage with their peers and the instructor(s) around the challenge.	2. **Middle Phase: Informing approaches to problems**. Here, instructors help introduce important science and engineering principles, practices, frameworks, and approaches informed by community needs. These will build upon students' initial ideas for addressing the environmental challenge in context. These are the things that students learn in the course that they may not have considered otherwise.	3. **Final Phase: Developing informed solutions** for addressing the community environmental challenge. Building upon intial ideas, this is where students revisit their initial proposals and strengthen them with what they learned about engaging in previous 'informing solutions problems' mid-instruction experiences with peers and instructors.

and places where our E-Corps model is being tried (Honig, 2006; Means & Penuel, 2005), both at UConn and, potentially, other universities. This is accomplished through negotiated joint work at the institutional level that happens as project researchers and stakeholders within (e.g., professors, administrators) and beyond UConn (e.g., community partners) cooperatively plan and investigate efforts to refine, sustain, and scale our innovative public engagement model (Campbell-Montalvo et al., 2020).

Adaptation to Remote Learning

The onset of the COVID-19 pandemic in spring 2020 forced E-Corps, along with almost every other course at UConn, to adapt to remote learning as students did not return to campus after the spring break. This had effects both on the practicum projects of the Climate and Brownfields Corps, and the inaugural classroom semester of the Stormwater Corps. In fall 2020, with instructors given a little more latitude on teaching modes, the Climate Corps class was taught completely in remote learning mode

and the Brownfields Corps was taught in hybrid mode. In recognition of these drastic changes—particularly in the context of a program founded on small-team projects, fieldwork, and engagement—and the opportunity to learn from this situation, a modest amount of funds from the NSF grant has been redirected to study the COVID-19-related impacts on E-Corps instructors and students.

Evaluation

The external evaluation provides an independent perspective on the project's research, contributions, and quality of outcomes. All three aspects of the project (instruction, research, integration) are undergoing evaluation of some type, as can be seen in the following list of evaluation questions:

1. What are the strengths and limitations of the research design for (a) expanding and refining the E-Corps model and (b) examining the process of institutional change needed to support this model?

2. How well are data collection processes and instruments aligned to the project's research questions?

3. How well are the project's research findings supported by evidence?

4. What is the quality of the training provided to faculty who are implementing the E-Corps model?

5. What is the quality of the tools intended to support the use of the high-leverage practices by faculty and students?

6. To what extent does the project use findings from its own research to inform revisions to the E-Corps model and the policies, practices, and tools needed to support its implementation?

7. To what extent do E-Corps projects meet the real-world needs of community partners and result in community organizations shifting toward more evidence-based practices?

To date, early into the 2nd year of the 5-year project, the emphasis has been on the formative elements of the evaluation plan. Members of the evaluation team attend all project meetings, and their first-year report focused on the effectiveness of the organizational structure and internal communication and planning of the project. In addition, the team meets regularly with the research team and principal investigator to ensure close coordination and avoid overlap or confusion between the research and evaluation efforts. During the 2nd year of the project, a major focus will be on interviews with representatives of E-Corps partner communities, in order to determine what is working, and not working, from the towns' perspectives, thus providing guidance for the instructors to improve the design of the practicum semesters (and likely influencing the content of the classroom semesters as well).

Integration: Sustainability Challenges and Opportunities

Key to the E-Corps initiative is the examination of mechanisms for sustaining this type of instructional model in the face of a number of challenges. All three aspects of the project are involved with this endeavor: the instructor team identifies these challenges, the integration team focuses on administrative responses, and the research team documents and explores those responses. Challenges are many, but for the most part they can be distilled into several major issues. These are summarized briefly here, with the acknowledgment that these issues are, at this point of the project, based almost completely on the experiences of the instructor team and are not yet supported or refined by research or ev;aluation results.

First, the model demands a higher commitment of instructional time and effort than most traditional classes. In addition to the many tasks involved in implementing a course that makes use of multiple interactive instructional techniques, there is the solicitation and coordination work with towns, and the logistical work involved with sustaining multiple field projects at the same time. All E-Corps instructors are in agreement that to implement an E-Corps course as a single faculty member would be extremely difficult. To add to this, the current system of faculty incentives and rewards is not designed to encourage this type of commitment, despite the model's many rewards to students and communities. One small step in this direction, funded by the NSF grant, is that each E-Corps class has been assigned a graduate assistant to help with some of these tasks. This has been an enormous help, but has not, to date, obviated the need for a two-instructor system.

Second, the model depends heavily on the participation of extension faculty (or their equivalents), not only for their knowledge of, and relationships with, the communities of the state, but as instructors that have a true feeling for the way environmental issues play out at the local level. Extension administration support of this involvement has two aspects, financial and philosophical. In our case, the critical issue is financial: Most of the extension faculty involved in E-Corps are primarily dependent on grant funds. This is an obvious and major challenge to sustainability of this model at UConn, and there is no getting around the fact that a greater commitment to supporting these faculty is needed for the model to survive. Perhaps a more widely applicable potential problem (although this has not been our experience at UConn) is that extension administrators may not be supportive of this modification of the role of an extension professional; faculty with 100% "extension" appointments and no "teaching" appointments might be seen as inappropriate instructors. Our answer to this is that the E-Corps model harnesses the enormous power of energetic and committed undergraduates to, in effect, multiply the impact of ongoing extension work within the community—and as such is not only a viable extension model but a desirable one. In our view, new pedagogical models like this more fully realize the land-grant/sea-grant ethos of the integration of research, teaching, and outreach.

The third major challenge revolves around working across administrative boundaries. For instance, one of the first challenges for the Climate Corps course was cross-listing it at three different schools/colleges across the university. In this case, the directors of the three environmental majors played a key role within their school/college Course and Curriculum Committees in explaining the Climate Corps with committee chairs prior to a presentation of the Climate Corps course to the committees and subsequent vote. But it was an uphill battle that took over a year. More telling, perhaps, is that even with the Climate Corps leading the way, it also took the Brownfields Corps over a year to perform the same feat. This served to remind the team that working across college and departmental lines, while theoretically encouraged by various levels of administration, is rarely simple in reality and that new procedures are needed to facilitate such efforts.

Taking Stock and Future Plans

The collective experience of the E-Corps team dates back to the AY 2017–2018 debut of the Climate Corps, although the NSF project, with its addition of research and evaluation, is only entering its 2nd year. As we await the results from those efforts, it is still possible to make some general observations about our experience to date, looking through the lens of its goal to simultaneously benefit four constituencies: faculty, students, communities, and the university. The seven instructors have found the experience of teaching these courses to be enormously gratifying but somewhat exhausting. Perhaps in the future these courses could be offered every other year rather than annually, but the student demand, and our desire to keep up the momentum of the model in its early stages, currently argues against that. It is also clear that the model as constituted at UConn is built on the long-term relationships that extension faculty (or, in the case of the Brownfields Corps, CBI faculty) have with the communities of the state. Although a deep pool of this type of experience and expertise exists across the country, particularly in the land- and sea-grant networks, prospects for adapting this model remain unclear. We hope to develop at least one more E-Corps offering during the course of the NSF project (a Mapping Corps based on a partnership between the Department of Geography and CLEAR), and beyond that perhaps facilitate the creation of non-STEM adaptations in the years to come. For instance, E-Corps principals have had preliminary discussions with both the School of Social Work on a collaboration focusing on environmental justice, and with the Department of Agricultural and Resource Economics on a master's-level effort that would develop economic analyses for towns. With each new version of the model will come more understanding of the ways in which faculty can use different approaches to reach our common goals.

In the absence of research and evaluation results to date, gauging student reaction is limited to formal teaching evaluation scores (which have been very high, above departmental averages) and informal student comments, both solicited and impromptu. One theme that has emerged in student feedback is the workforce preparation benefits of this approach, as seen in the following:

I was struggling to find an area of

interest that I could legitimately see myself pursuing for an extended period of time at some point in the future and, likewise, actively making a difference while doing so. My struggles ceased after taking the Climate Resilience and Adaptation/Municipal Policy and Planning course . . . for the first time ever, I was able to envision myself in a position in which I would be working in this field in the future/post-graduation.

This course was my favorite one I've taken in my undergrad career. I think I've learned so much more in these past two semesters than I have in any other class. It has prepared me for the professional world and gave me the feedback to improve my skills along the way. A lot of topics related to brownfields, assessments, and remediation was taught in this class that was not taught anywhere else in my undergrad career. I'm very excited to watch all of the incredible things to come from this class.

Impact at the municipal level is also anecdotal. There are certainly many positive stories, including communities that have used E-Corps reports as the basis to change their policies, apply for grants, or educate their citizens. And of course, there is the $1.1 million dollars in grants to communities obtained for brownfields work. Challenges remain, however, and to date many of them relate to the difference between the compressed timeline of a university semester and the extended time frame under which most municipal operations and decisions take place. In the earliest years, student teams would be left waiting for feedback or information from town officials as the semester clock ticked away. The addition of the graduate assistants to help facilitate communication and logistics has greatly helped in this regard. Impact at the local level is intimately connected with the benefits to the university, since this goal refers to an increase in awareness of, and appreciation for, the university for the application of its resources to help to solve community problems. Although it has been temporarily suspended due to COVID-19, the team has also implemented a recognition system in the form of an E-Corps plaque for each town, expressing appreciation and noting the town's partnership with UConn.

Four years is a relatively short time, from the perspective of the authors, to move from an interesting idea to a pilot project bootstrapped by a seed grant to a full-blown (if not yet fully realized) academic initiative with a big cast of partners and many moving parts. As the E-Corps continues to evolve and mature, we intend to relate our experiences—win, lose, or draw—to our peers in the hope that they will be of value.

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Acknowledgments

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Problematizing the Relationship Between Cultural, Social, and Political Capital and Graduate Student Participation in a Community Engagement Professional Association

Lori E. Kniffin, Trina L. Van Schyndel, and Elisabeth G. Fornaro

Abstract

The Graduate Student Network (GradSN) brings together emerging scholars who have an interest in research on service-learning and community engagement (SLCE). In this reflective essay, we problematize the relationship between social, cultural, and economic capital and graduate student participation in the GradSN, specifically the GradSN chair role. To begin, we share the origins, process, and initial findings of a collaborative autoethnographic study that involved a group of seven past, present, and incoming chairs. Participation in this study led us to question what barriers exist for graduate student participation in the GradSN, resulting in this reflective essay. Second, we share the critically reflexive practice the three of us engaged in to interrogate our identities in relation to our chair role. Finally, we discuss the concept of full participation as a way to disrupt current structures in the GradSN, concluding with ideas for future inquiry and action.

Keywords: graduate education, critical reflexivity, community engagement, service-learning, full participation

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The Graduate Student Network (GradSN) brings together emerging scholars who have an interest in research on service-learning and community engagement (SLCE). The GradSN is an affiliate organization of the International Association for Research on Service-Learning and Community Engagement (IARSLCE) and is governed by a small elected executive committee that includes a chair-elect, chair, and immediate past-chair. Current GradSN chairs also serve on the IARSLCE board. We, the authors of this reflective essay, have served in the GradSN chair role, and subsequently on the board of IARSLCE.

In this reflective essay, we problematize the relationship between social, cultural, and economic capital and graduate student participation in the GradSN, specifically the GradSN chair role. We do this by examining our own motivations for seeking this role, reflecting on the relationship between our identities and our experiences, and identifying patterns of power and privilege in the chair role. To shape this discussion, we begin by sharing the origins, process, and initial findings of a collaborative autoethnographic study that involved a group of seven past, present, and incoming GradSN chairs. Then, because participation in this study led us to question what barriers exist for graduate student participation in the GradSN, we share the critically reflexive practice the three of us engaged in to interrogate our identities in relation to serving in the chair role. Finally, we discuss the concept of full participation as a way to disrupt current structures in the GradSN that create barriers to participation. We conclude with ideas for future inquiry and action.

Our Collaborative Autoethnographic Study

The question that guides this reflective essay grew out of the authors' work on a collaborative ethnographic study (Kniffin et al., 2021). In 2018, a small group of GradSN chairs (current and past) were on a call discussing the work of the GradSN as related to the IARSLCE strategic plan. On this call, this small group (including two authors of this article) decided to collaborate on an IARSLCE conference proposal related to this discussion, which touched on our experiences as chair. After positive feedback from additional past-chairs, the small group decided to invite all seven past, present, and incoming chairs to contribute to a study on the role of the GradSN chair. This Institutional Review Board–approved study examined the motivations, experiences, and professional impacts of the GradSN chair role with regard to our professional development as practitioner–scholars.

The seven chairs span different ages, professional positions, doctoral program phases, and personal life stages. Because the aim of the collaborative autoethnography was to understand motivations, experiences, and professional impact, it was important that we design a process that was inclusive of the busy graduate student, the administrator with a tough schedule, the new mom, and other identities that can often be barriers to participation in collaborative scholarship. Multiple methods of participation were offered, including emails, phone/video chat, and Google Docs, in recognition of varying life stages and life events taking place for each participant throughout the course of the study. We also found collaborative autoethnography to be a method of inquiry that met our democratic aims and research goals. This method allows groups to contribute personal written narratives through a collaborative process. We used Chang et al.'s (2016) four-stage iterative process as a foundation for our process, which then evolved to six stages: (1) developing writing prompts, (2) a first round of self-writing, (3) sharing and probing, (4) a second round of self-writing, (5) analysis, and (6) final writing. This allowed all to participate in self-writing and enabled a smaller group to continue to participate in additional probing, meaning-making, and final writing.

Initial findings presented at the IARSLCE annual conference (see Kniffin et al., 2018) showed that the chairs were motivated both extrinsically (e.g., prior positive experiences with IARSLCE) and intrinsically (e.g., desire for professional growth). Additionally, their experiences were facilitated through opportunities both formal (e.g., organized conference events) and informal (e.g., personal and professional relationships). The professional impacts included finding front doors (e.g., direct personal invitations) and winding pathways (e.g., making connections/networking) into the work.

Although the initial findings of the collaborative autoethnography yielded interesting results related to the motivations, experiences, and professional impacts of our roles as GradSN chair, the collective meaning-making process compelled us to examine something beyond the scope of the study. At the time of the initial findings, the immediate past-chair, chair, and incoming chair (the authors of this reflective essay) felt the need to examine the patterns of privilege that were evident in our stories to further unpack our experiences and to critically think about how our existing capital impacted our experiences in the GradSN. This led to the reflective question guiding the remainder of this essay: What is the relationship between cultural, social, and economic capital and graduate student experiences in professional associations, such as the IARSLCE GradSN? Next, we share some of our critically reflexive practice and then discuss potential implications.

Critical Reflexivity

During the collective meaning-making process of the collaborative autoethnography, we decided it was not enough to merely look at the motivations, experiences, and professional impacts of our role as chair without understanding how we came to access those experiences and develop those motivations. Therefore, the three of us decided to explore the relationship between our identities and experiences connected to our role as chair. We began by writing individual critical reflexivity statements (Pillow, 2003) to name, explore, and question our identities, power, and privilege. Reflecting on these statements together, we found that various forms of prior capital were evident in our pathways to becoming GradSN chair. As a way to unpack the relationship between culture and power, Bourdieu (1986/2011) spoke to the role of capital—a type of currency or credit—that can be applied in various fields

(e.g., educational, political) or exchanged (e.g., cultural capital to economic capital; Levinson, 2011). Bourdieu described three types of capital:

> *economic capital*, which is immediately and directly convertible into money and may be institutionalized in the form of property rights . . . *cultural capital*, which is convertible, on certain conditions, into economic capital and may be institutionalized in the form of educational qualifications, and . . . *social capital*, made up of social obligations ("connections"), which is convertible, in certain conditions, into economic capital and may be institutionalized in the form of a title of nobility. (p. 82)

Although everyone possesses different forms of capital, certain forms are valued by those in power, leaving the capital of targeted identities (i.e., those who are controlled, disenfranchised, and marginalized) unacknowledged or devalued (Yosso, 2005).

We believe the cultural capital we gained through the chair position grew exponentially from existing capital. Although our individual agency was important to our choice to take on and invest our time in the role of chair, we also recognize that some aspects of our identities allowed us to ride an exponential curve of privilege in ways others may not be able to. The role of privilege in our stories becomes more problematic when we look at the largely homogeneous composition of the past, present, and incoming GradSN chairs. All seven of us who participated in the collaborative autoethnographic study are White females who reside in the United States, speak English, and are pursuing or have obtained a terminal degree in education. Although we recognize that we bring diverse perspectives from our geographic regions, disciplinary training, and life experiences, we acknowledge that we are not fully representative of emerging community engagement practitioners and scholars—something we unpack in more detail in our autoethnographic study (see Kniffin et al., 2021). The composition of the GradSN membership is more diverse than those who have led it, but it is still heavily White, female, and U.S.-based. Our identities (those of the authors of this essay) represent primarily majority identities and do not represent the full spectrum of emerging SLCE practitioner–scholars' identities. Thus, we recognize that while we are experiencing the benefits of both privileged identities and prior capital, we are also participating in a system that reinforces patterns of privilege and power that contribute to underrepresentation of diverse voices in the field, within the GradSN, and in the chair role.

An "interface" between individual and structural factors carved our paths to the GradSN chair position (Halualani et al., 2006, p. 72). Systems of power privileged singular and interacting aspects of our individual identities along the way. We consider our identities as assemblages, which are the "collections of multiplicities" that describe our social identities and positionalities at any given time (Puar, 2007, p. 211), and we understand that these assemblages can shift depending on the situation. In our case, the assemblage of each of our identities and the privileges they held over time afforded us the capital required to access the chair role. For example, we all benefited from *social capital* such as strong mentors and personal support systems at our institutions and in IARSLCE. Although being female is a minoritized identity, we each still benefited from the fact that there are many White females in the SLCE field who provide us with visual markers showing us we belong. Furthermore, we all identify as having *economic capital* either from our personal or professional financial situations. This affords us not only educational opportunities, but also the ability to travel to and attend conferences, which provided even more mentorship, connections, and opportunities for leadership. Additionally, our experiences in terminal degree programs in education have provided us with not only formal knowledge, but also *cultural capital* in the form of cultural signals (Lamont & Lareau, 1988) valued in research associations.

The capital we possess is also connected to structural factors. Although IARSLCE is an international association, its members predominantly work at U.S.-based institutions. As we are all studying at U.S.-based institutions, we often benefit from the location, language, and time zone utilized in practice. This became more apparent to us when the IARSLCE conference was held in Ireland, and we unsuccessfully attempted to recruit students studying outside the United States who expressed interest in the GradSN but ultimately found barriers to participation.

Moving Toward Full Participation

On paper, the GradSN chair position is available to all graduate students who have an interest in SLCE, including prospective students, students in between programs, current master's and doctoral students, and recent graduates. There is no IARSLCE membership requirement or membership fee. There are no prerequisites or merit-based criteria. An individual just needs to apply and be a graduate student who is willing to convene and facilitate a group of SLCE graduate students. Yet, despite what seem at face value to be low barriers to participation, through our reflections we have surfaced that the chairs have been and continue to be a homogeneous group, one that is not reflective of Post et al.'s (2016) characterization of the next generation of student scholars as "a much more racially and ethnically diverse group" (p. 1). As we seek to achieve the democratic and social justice aims central to the SLCE field, we must address that the homogeneity of this group is likely tied to prior cultural, social, and economic capital.

Part of the challenge in addressing homogeneity may be the nature of winding pathways that characterize many community-engaged practitioner–scholars' narratives. Anderson-Nathe et al. (2016) wrote, "Seldom are these paths direct or linear. Instead, they wind and amble, charted by humans engaged in complex relationships with a complex world" (p. 170). Further, Kniffin et al. (2016) pointed to the connection between capital and winding pathways into graduate programs that focus on SLCE. They wrote:

> Students without a high level of persistence, the resources to devote significant time and attention to the search for a program, and/or strong connections in the field may never find these pathways—with the consequence that the SLCE movement may lose their participation and leadership. Further, the movement may disproportionately lose the voices of students who lack the privilege of access to the human, cultural, and economic capital needed to pursue such winding pathways toward SLCE. (p. 92)

Interrogating pathways into professional organizations and networks from a lens of capital may highlight more barriers to entry than simply assessing eligibility criteria and application processes.

Given the capital and privileges that encouraged our journeys and enabled us to excel, we are curious as to how we can look beyond ourselves to invite changes in the organization to make it more welcoming and accessible to minoritized identities, including along the lines of race/ethnicity, nationality, gender, sexual orientation, ability, or socioeconomic status. Full participation, "an affirmative value focused on creating institutions that enable people, whatever their identity, background, or institutional position, to thrive, realize their capabilities, engage meaningfully in institutional life, and contribute to the flourishing of others" (Strum et al., 2011, p. 3), helps us consider how we can work with others to create change so that there are inclusive and equitable processes and structures in the GradSN. In the next section, we describe future practices that can lead toward more inclusive pathways and full participation.

Recommendations and Future Research

Taking time to reflect individually and collaboratively is important for both scholarship and practice; therefore, our reflective process and this essay are valuable in their own right. However, stopping at reflection in this case would do little to remedy the issues we have raised. In concluding this reflective piece, our initial inclination was to name future inquiry as next steps. For example, our reflective piece is limited to the experiences of the three authors, and we believe there is value in additional inquiry into the experiences of graduate students in the GradSN (and IARSLCE more broadly) who have not sought the GradSN chair role, as well as inquiry into graduate student experiences in other similar professional associations. Naming future inquiry as a next step is a practice within our comfort zone as practitioner–scholars. But we also feel called to name future actions and ask how we might leverage our capital to make space for others in an organization we care about.

There are a few initial actionable next steps we suggest for the GradSN. The first is to seek additional funding to support those without economic capital to attend the annual IARSLCE conference. Additionally, providing virtual spaces for collaboration and professional development alongside the in-person spaces would increase accessi-

bility. Similarly, we recommend engaging SLCE graduate students who cannot attend the annual conference in the organization's mentoring program, which has traditionally revolved around the conference. Beyond the annual conference, the GradSN might consider creating alternative means of collaboration and meeting that are more inclusive of people based outside the United States, such as international chapters of the GradSN. Additionally, programming could be designed specifically for varying stages of degree programs and research experience, including those seeking master's degrees or nonterminal graduate degrees. We also suggest creating additional spaces, connected to in-person and virtual programming, for minoritized identities to connect in addition to general sessions for all graduate students.

Although we feel these action steps are important, we want to end with a caution that we alone are not the ideal actors to determine next steps. Doing so without collaboration from those who are already absent from the conversation may reinforce problematic systems already in place. Ideally, we must both share our critiques broadly and engage in dialogue with others (especially those with minoritized identities) to work toward full participation within the GradSN. Therefore, effective next steps might be more process oriented, such as (a) advocating for critical reflexivity on behalf of GradSN chairs so that we are continuously improving how the GradSN seeks to support a diverse community of community-engaged practitioner-scholars, (b) partnering with and learning from the Imagining America Publicly Active Graduate Education (PAGE) Fellows, another SLCE graduate student group affiliated with a professional organization that has more explicitly sought to advance full participation, and (c) designing research projects that inquire about the experiences of graduate students not only at their home institution, but also with professional associations.

Conclusion

In this reflective essay, we describe the process by which our collaborative auto-ethnographic study led us to further critical reflection on the power and privilege that enabled us to take on the GradSN chair role. The intent of this essay is to critically reflect on how the social, economic, and cultural capital that we possessed prior to our role as GradSN chair facilitated our journeys into that position. This included examining our own motivations for seeking this role, reflecting on the relationship between our identities and our experiences, and identifying patterns of privilege in the chair role. In summary, to encourage participation and leadership from those lacking the privileges or prior capital possessed by the previous GradSN chairs, the members of the GradSN must actively take up the call of full participation across the professional association. We must actively seek representation of more diverse voices in GradSN general membership, as well as specifically in the GradSN chair role. We must also seek to address inequitable structures and processes that may be barriers to inclusion of diverse voices in these roles.

We recognize that our three perspectives are limited, and the knowledge we have generated cannot be generalized to broader audiences. Instead, we hope that sharing our process of problematizing our roles through critical reflexivity and discussion will encourage others to critically examine their identities, their roles, and the operation of power and privilege in their own area of community engagement. We hope this essay raises questions more than provides answers and encourages others to consider the role of capital when developing experiences for graduate students in SLCE professional associations and beyond.

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