Reevaluating Traditional International Service-Learning during a Global Pandemic

JAY H. AREHART
University of Colorado Boulder
Boulder, CO

KATHRYN L. LANGENFELD
University of Michigan
Ann Arbor, MI

AND

ETHAN M. GINGERICH
Engineers in Action
Tulsa, OK

ABSTRACT

The Engineers in Action (EIA) Bridge Program provides engineering students with international service-learning opportunities through design-build footbridge projects. The conventional project model relies on an implementation trip as a primary learning activity. Prior to the pandemic-caused cancellations of all implementation trips in 2020, EIA resources were already being allocated to increase on-campus learning activities in an effort to improve the inclusivity of the program to students without the financial means to travel and forego paid internships. Online courses were developed using Open edX (https://eiaeducation.org) and the focus of students was shifted from preparing themselves to implement the bridge projects in person, to aiding local staff and communities to implement the projects without EIA students onsite. All student chapters remained actively engaged in their projects through the adapted project preparations and online courses. The successful adaptation of a service-learning project to an online format suggests that students still highly value these educational experiences. In the future, service-learning projects should consider offering online formats to engage more engineering students across a wider range of institutions.

Key words: service-learning, online education, community development

INTRODUCTION

The Bridge Program of the non-profit organization, Engineers in Action (EIA), engages university students in the design and construction of pedestrian bridges in Bolivia and Eswatini.

The implementation trip serves as a very influential and impactful learning activity for students. In spring and summer of 2020, the COVID-19 pandemic led to international travel restrictions imposed both by the universities participating in EIA bridge projects and by the countries in which projects are implemented. The EIA Bridge Program is one of many engineering projects with travel components postponed indefinitely due to these restrictions, including student design competitions (*e.g.*, Gadola & Chindamo 2019), Engineers Without Borders (e.g., Oaks *et al.* 2019, Witting 2013), and university-based service-learning projects specific to individual universities (e.g., Ellzey *et al.* 2019, Ranger & Mantzavinou 2018). As universities have moved their instruction online, service-learning activities contingent upon domestic or international travel have faced the unique challenge of providing a remote or virtual learning opportunity to replace the traditional implementation trip.

Prior to the pandemic in the 2019–2020 academic year, 17 student chapters participated in the EIA Bridge Program. These student chapters were primarily from the United States with four chapters in Canada and one chapter in the United Kingdom. In a typical project, student chapters work with local EIA staff, who have identified communities in need of footbridges. Students then design a footbridge under the supervision of a professional engineer and prepare a construction implementation plan. The students then travel to live and work alongside a rural community for six to eight weeks while constructing the footbridge. The service-learning experience of the design-build construction project addresses many of the American Board of Engineering and Technology (ABET) learning outcomes, which are designed to supplement formal engineering curricula. While these learning objectives in Table 1 are specific to an EIA footbridge project, they also have applicability

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Table 1. Learning outcomes associated with student participation in an EIA footbridge project.

1. Apply engineering judgement and design principles.

2. Pursue a project from design to completion, implementing project management skills.

3. Collaborate with external stakeholders (*i.e.* partnering nonprofits, local municipalities, partnering communities, alumni, other EIA university programs, sister academic institutions abroad).

4. Create engineering designs that are sustainable, community-driven, and empower long-term development.

5. Evaluate the technical and ethical implications of civil engineering infrastructure.

6. Apply a systems thinking approach to solve problems and make connections across multiple disciplines in an engineering project.

7. Evaluate the role global engineering plays in the world.

8. Understand the differences between a footbridge project and formal engineering education, and why these differences exist.

9. Create viable solutions to real-world problems.

10. Understand that continuing education is necessary to adapt and overcome ever-changing adversity.

11. Analyze your own transformation by reflecting on the knowledge and perspective you gained throughout the project.

to service-learning projects in other disciplines which involve multiple stakeholders and complex engineered systems. The activities used to support the learning outcomes are fourfold: (1) on-campus training through asynchronous online courses focused on the different aspects of a project, (2) two design reviews in which students present their design and construction plans to a technical review board who give feedback and final approval, (3) travel to the construction site to implement the project, and (4) post-travel reflection.

An ongoing issue of international service-learning projects is the cost to participate. Limited scholarships and institutional resources exist to cover student travel and living expenses, so many students must pay or personally fundraise for their own expenses and frequently forfeit paid internship opportunities to participate in the implementation trip. This can restrict student involvement to those with financial resources. Since the benefits of service-learning projects are wide-reaching (Stukas *et al.* 1999), they should not be limited to those individuals and institutions with the financial resources to provide international travel experiences. Providing more on-campus learning opportunities and activities, and reducing a program's reliance on implementation trips, will improve the inclusivity of service-learning projects.

Even before the pandemic, momentum within EIA has shifted resources towards providing more on-campus learning activities, such as asynchronous online courses, to expand learning opportunities. This shift came in-line with other efforts within higher education efforts to increase the availability of E-service-learning (Waldner *et al.* 2012). With the pandemic, EIA has had to further reevaluate the organization's project model for the better. Providing project opportunities to students without the need to endure the financial hardships associated with travel will allow these projects to be accessible to any engineering student, regardless of external crises.

METHODS

Even though international travel was cancelled due to the COVID-19 pandemic, project commitments had already been made with communities in Bolivia and Eswatini. Thus, students shifted their focus from preparing their implementation trip to preparing a team of in-country staff to implement the project. No additional in-country staff was hired in response to the pandemic. The existing in-country staff are engineering professionals hired to identify sites and aid students in the pre-travel site preparations and local, skilled masons that typically work with students during construction. The scope of work was extended for the in-country engineers but was not significantly altered for the masons. In addition, further efforts were devoted to the expansion of the EIA online learning platform, adding to existing courses and creating three new courses (project management,

construction management, and chapter operations), as these courses became the focal point of the program curriculum. The EIA online learning platform (https://eiaeducation.org) utilizes Open edX to deliver asynchronous online courses on both technical and non-technical topics related to the design, planning, and implementation of pedestrian bridges. At least one student from each team is required to complete each of the courses, yet students are encouraged to participate in as many courses as they would like. As a result of expanding the online learning platform, we found that, with only the online courses, seven of the eleven learning outcomes can be fully achieved by students, while the remaining four (outcomes 2, 3, 4, and 6) could only be partially achieved with the current scope of the online curriculum.

PRELIMINARY RESULTS

Students continued with the development of their bridge design and implementation plans, with 12 out of 17 chapters completing their design and construction reviews on-time. The remaining five were most affected by the pandemic and required extensions to their deadlines but are scheduled to finish before the start of the fall semester. This progress shows that students are still engaged in the projects even with the disappointment of not travelling. Because students were already comfortable working in remote formats with staff and partners across the world through EIA's online learning platform, the transition to remote working formats was not as dramatic as other extracurricular activities may have faced. In addition, outcomes were both measurable and positive. As of writing (August 2020), one of four bridges was completed in Eswatini and one of three bridges is under construction in Bolivia and all bridges are on track to be completed in 2021. Achievement of learning outcomes under pandemic conditions were compared to 2019 based on results from end-of-year surveys where students self-report if they improved or not for each of the learning objectives. In 2019, the average positive response for achieving the learning objectives was 91% (4.6% standard deviation, n = 98). Without traveling this year, the average positive response decreased, as expected, to 74% (6.8% standard deviation, n = 90).

There are key aspects of the learning experience that could not be replicated during remote and online work. For instance, the immersive experience that comes from living and working alongside the direct beneficiaries of a footbridge project cannot be realistically replicated in an online form. As the pandemic persists, service-learning programs, EIA included, must consider how service-learning learning outcomes can still be achieved when the opportunities for community engagement are severely limited.

NEXT STEPS

The future of service-learning projects that involve international travel continues to remain uncertain. This pandemic has enabled a shift in mindset about how service-learning projects can be implemented in engineering curricula. We have found through end-of-year surveys that although students achieve fewer of the learning outcomes, they are still excited to engage in international service-learning projects even without travelling. In the 2020–2021 academic year, we plan to expand upon the asynchronous courses to better engage students in the critical thinking opportunities that typically come from travel. To supplement the asynchronous courses, synchronous problem solving studios (Le Doux & Waller 2016) will be facilitated remotely by EIA staff members and/or faculty advisors. In these sessions, students will be required to first identify what the root cause of the problem is, distill what information is required to develop multiple potential solutions, and evaluate each solution.

An indirect benefit of a more thorough online service-learning experience is that it allows more students to be engaged in projects. For example, senior capstone projects that have difficulty with the physical distancing requirements and need to shift to fully remote or online teaching modalities could make use of existing online service-learning curricula, including that of EIA. In addition, higher education institutions without the financial resources available to invest in costly travel-based international service-learning projects can offer online opportunities instead. We encourage other organizations to consider investing in online curricula and projects so that more students can experience the benefits that stem from service-learning.

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AUTHORS

Jay Arehart is an Instructor in the Department of Civil, Environmental, and Architectural Engineering at the University of Colorado Boulder and has volunteered as the Education Manager for the Engineers in Action Bridge Program since 2017. Jay teaches a variety of engineering courses, including architectural studios, senior capstones, and sustainability courses. In addition, he is a PhD Candidate at the University of Colorado Boulder with a research focus on quantifying and reducing the embodied carbon of buildings.

Kathryn Langenfeld is an environmental engineering Ph.D. student at the University of Michigan and University Relations Committee Chair for Engineers in Action Bridge Program. She has volunteered with the Engineers in Action Bridge Program since 2012. Her doctoral research focuses on developing methods to investigate the viral community of wastewater to elucidate the role of bacteriophages on the dissemination of antibiotic resistance genes during wastewater treatment.

Ethan Gingerich is the Bridge Program Director for Engineers in Action. He graduated from the University of Iowa with a degree in civil engineering with a focus on structures meanwhile leading multiple footbridge projects in Nicaragua. Before directing the EIA Bridge Program, Ethan served as the Bridges to Prosperity University Program Coordinator and worked as a structural engineer on international and domestic development projects with JZ Engineering (Harrisonburg, VA).