



Engagement in Practice: A Case Study on Improving Community Sustainability through Service Learning

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Engagement in Practice: A case study on improving community sustainability through service learning

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Abstract

Service-learning programs have been identified as an important contributor to campus and community or “town and gown” relationships. These relationships offer the potential to tackle societal problems that are too large for any single organization. **In addition, assessments have shown that engineering students engaged with community partners on design projects have a stronger view of engineering as a means to better society and are more likely to be involved in their communities after graduation.** This paper presents an overview of service learning and community engagement with an emphasis on sustainability. In particular, it highlights a case study of the EPICS Sustainability team and their partnership with the Rapid City Sustainability Committee (RCSC). The paper highlights the positive effects of the partnership between the student-led design team and the city on the students, the campus, and the community.

In 2011, the City of Rapid City, South Dakota established the Rapid City Sustainability Committee (RCSC) whose mission is to encourage education, stewardship, and policy leadership to increase the economic, social, and environmental sustainability of the community. A recent priority of the RCSC is to improve energy efficiency of city buildings to meet EnergyStar standards. In the fall semester of 2017, an official partnership between the RCSC and the Engineering and Science Projects in Community Service (EPICS@mines) program at the South Dakota School of Mines and Technology (SD Mines) was formed to help the RCSC meet this goal. The EPICS@mines program allows students to earn course credits for partnering with the committee to investigate, monitor, and plan an initiative for improving the energy efficiency of city buildings to meet Energy Star Building Certification. The creation of the student design team has had a positive impact on students and the community and it has led to the development of unanticipated partnerships in the community.

Introduction

Town and gown relations have long been considered important to the success of a university, and both the community and the institution can benefit when successful collaborations are developed. Many approaches to developing connections between higher education institutions and the surrounding communities start with a top-down administrative approach [1] But improved community relationships can, and often do, occur due to individual or small team initiatives.

Methods for developing community engagement may be economic or cultural, and the best relationships are mutually beneficial. Even more significantly, these collaborations allow for a more promising approach to solving larger problems in society. A recent article in the Chronicle of Higher Education [2] looked at what responsibilities an institution has towards the community; suggestions to meet these obligations included initiatives such as cooperation with community-based organizations that include learning opportunities for students. Martin et al. [3]

point out that often societal concerns are too large to be solved by single entities, and university/community partnerships increase the likely impact of any endeavors. Community engagement may have impact beyond the local community level through state, regional, and international scales, but the grounding of all engagement and the core to creating any sustainable impact is creating a foundation at the local community level [4].

Numerous models for campus engagement in the community exist ranging from K-12 outreach in classrooms, student volunteerism, service provisions, faculty involvement, applied research, and service learning [3]. It has been suggested that service learning was a natural extension of the activism of the 60s, much of which centered around college campuses [4]. As a natural extension from the activism of the 60s to the global environmental awareness of the new millennium, sustainability in communities can be promoted through community engagement using service learning as a mechanism [5].

Although sustainability assessments and processes are highly varied in literature [6], it has been widely acknowledged that sustainability meets the three pillars of environment, society, and economy, or the triple bottom line. And while methods such as life cycle assessment are recognized as an important tool in sustainability assessments, this tool places its emphasis in the environmental pillar of sustainability, and is poorly equipped to assess the societal pillar [6]. Community engagement and participatory design is recognized as one tool for progressing sustainability in design. For example, the Institute for Sustainable Infrastructure (ISI) developed the Envision infrastructure rating system to evaluate the sustainability of major infrastructure projects. The Envision system incorporates the societal pillar of sustainability through promotion of stakeholder engagement and participatory design, recognizing tools such as stakeholder surveys, town hall meetings, design charrettes, participation of stakeholder representatives on design teams, and the use of social media to provide input throughout the design process [7]. Thus, it is reasonable to expect that by partnering and engaging students, faculty, and community members in community sustainability projects, there would be high potential of achieving the purposes of improving student understanding of sustainability and enhancing their professional development and of addressing the societal pillar of sustainability in design.

EPICS@mines

In 1995, Purdue University established the first EPICS program. EPICS is a model service learning program in which multi-disciplinary teams of undergraduate students from freshmen to seniors partner with community organizations “to address human, community and environmental needs” (<https://engineering.purdue.edu/EPICS>). Currently 29 universities have modeled service-learning programs after the Purdue program and are part of the University Consortium plus an additional 13 institutions in India. EPICS@mines was established in Fall 2016 with four project partners and 20 students. The program is the first EPICS consortium members that includes a collaboration with a tribal college, Oglala Lakota College, and it is unique among EPICS consortium members in its commitment to engaging Native American students through its focus on projects that are meaningful to their communities.

The program utilizes a human centered design model [8] that requires them to obtain feedback on a regular basis from their community partners and consider the impact of the design on stakeholders of the project. Students involved on EPICS teams are engaged in empathetic design

which allows them to focus on the human, societal, and environmental aspects of their design and the design process. Rather than a “design for” philosophy, teams are infused with the concept of “working with” the stakeholders in the design. In addition, projects are not tied to a semester timeline and may run multiple semesters or years alleviating the negative attributes that often accompany projects that are rushed to completion to meet a semester deadline.

The EPICS service-learning model has very positive attributes with respect to student outcomes and town and gown relationships. Beyond outcomes related to design skills, stated outcomes of the academic course include:

- ***Stakeholder Awareness***: an awareness of the stakeholders
- ***Teamwork***: an ability to function on multidisciplinary and diverse teams and an appreciation for the contributions from individuals from multiple disciplines
- ***Communication***: an ability to communicate effectively both orally and written with widely-varying backgrounds
- ***Ethics***: an awareness of professional ethics and responsibility
- ***Social Context***: an appreciation of the role that their discipline can play in social contexts

ABET outcomes that are difficult to meet in traditional classroom setting, in particular f – h, are an inherent part of student participation on EPICS teams. In addition, alumni surveys of EPICS participants have shown that students better understand how engineering can benefit society and their participation ***increased their interest in participating actively in their communities*** [9]. It is also worth noting that the EPICS mission to address “human, community and environmental needs” are very closely related to the three pillars of sustainability, environment, society, and economy.

Both universities and communities can leverage EPICS projects in helping to address the types of societal problems previously described as difficult to solve by individual entities. In particular, benefits to the community of EPICS projects stem from the continuity, technical depth, and disciplinary breadth of the teams [10]. Also, students benefit from working with real clients who present real problems [11]. This experiential-based pedagogical approach significantly contrasts with typical engineering courses that employ faculty-centered instruction and deductive pedagogical approaches. Cortese [12] describes how typical pedagogy, which enforces individual achievement and competition, is antithetical to the development of students who can solve societal problems. The team-based, human-centered, societally-focused nature of EPICS projects is much better suited to develop graduates that are equipped to tackle societal issues.

EPICS@mines Case Study: Hardrocker Sustainability

In 2011, the City of Rapid City established the Rapid City Sustainability Committee (RCSC) whose mission is to encourage education, stewardship, and policy leadership to increase the economic, social, and environmental sustainability of the community. The 12-member volunteer-based committee has awarded projects, hosted conferences, and supported policies and outreach efforts. One significant issue in the community that the committee members expressed interest in addressing is that a 2017 American Council for an Energy-Efficient Economy

(ACEEE) scorecard on state efficiency policies ranked South Dakota at 49th in the nation. Following the concern of the RCSC over this report, the RCSC voted to approve the formation of a subcommittee to investigate Energy Star Standards for city buildings. However, because the RCSC is a volunteer-based committee and the city has no paid staff member tasked with addressing such a city-wide energy audit and plan for efficiency improvements, in the fall semester of 2017, an official partnership between the RCSC and the EPICS@mines program at SD Mines was formed to help the RCSC meet the goals of this subcommittee. Through the EPICS@mines program, students formed a team, the Hardrocker Sustainability team, to partner with RCSC, and students earned course credits for the investigation, monitoring, and developing strategies for improving the energy efficiency of city buildings to meet Energy Star Building Certification.

EPICS teams are not intended to be formed to work on specific projects, but rather to pair with community partners to address technically-focused needs of the partner that might not otherwise be addressed due to numerous issues including time and financial constraints. Consequently part of the team's task was to work cooperatively with the RCSC to perform a needs assessment. In September 2017, RCSC voted to form a subcommittee to investigate Energy Star Standards for city buildings; the Hardrocker Sustainability team was able to provide an avenue for the RCSC to begin the assessment and evaluation of city buildings. Because the RCSC is comprised of voluntary members and Rapid City does not have a staff member assigned to assessing building energy efficiency, the student team was able to provide technical expertise that would have been otherwise unavailable to the committee while receiving academic credit and professional development. The Hardrocker Sustainability team has, through the process described below, worked closely with the RCSC and local professionals to ensure a successful endeavor and eliminate some of the pitfalls often found on semester-long projects where communication is often limited to the beginning and end of the project periods.

The student team began by analyzing the energy bills for all city-operated buildings, based on records that they were able to obtain through the RCSC contacts. The final choice of a building was based on visibility, community benefit, and potential for energy efficiency improvements, based on voluntary consulting by the RCSC member who is also an electrical engineer and the Sustainability Coordinator with the local power company, Black Hills Energy (BHE). The building chosen is the City and School Administration building, which is operated 60% by the city and 40% by the school administration. While the split in responsibility for energy upgrades (and the potential financial benefit) added a layer of complexity for the student team, the potential financial savings to both the city and school was deemed to add more value to the community overall.

The student team developed a plan for, and conducted in mid-November 2017, an energy field audit with voluntary input from both the BHE representative and from a RCSC member who is the Sustainability Coordinator for Mount Rushmore Memorial Xanterra Parks and Resorts (Xanterra). Xanterra recently renovated buildings at the national memorial, located 18 miles from the SD Mines campus, to meet the US Green Building Council's Leadership in Energy and Environmental Design (LEED) and Energy Star standards, and Xanterra's project coordinator was willing to share his knowledge on their strategies and insight into this project.



Figure 1. Hardrocker Sustainability team presents results to the City Council

The students presented their results and recommendations to the RCSC on November 27, 2017. Their analysis revealed numerous energy efficiency deficiencies, including lighting, HVAC, office equipment, and space heaters, with the current building operations and highlighted several key strategies to improve efficiency and reduce operating expenses. Many of their recommendations were based on affordable technologies through BHE, and the students were able to provide these based on voluntary advising from the sustainability coordinator. As a result of their presentation, they were invited by the City Council Alderman who is a liaison to the RCSC to present at a City Council meeting, and the student team gained another informal advisor to the team, who is the current RCSC Chair and owner of a company, Advanced Light and Sound Services Inc., a local business that provides and installs smart technology and integrated systems for both energy efficiency and renewable energy projects.

The team revised their analysis, based on the feedback from the RCSC and community professional advisors, focusing on the energy savings potential for the replacement of inefficient lights to LED bulbs and fixtures. Including rebates, labor, and materials, the team found that replacing current lighting with energy efficient LEDs, would result in a \$200,000 savings over the 16-year lifetime of LED bulbs, a reduction of 75-tons of annual carbon dioxide emissions, and a 3-year return on investment. The team presented the results of their analysis at a city council meeting on February 20, 2018 (Figure 1). Following the presentation and subsequent press releases, the team advisors and student team have been contacted by many other city building representatives requesting similar analyses. The team has since been communicating with the city's Capital Improvement Plan Committee, who reviews proposed expenditures for capital improvements for streets, municipal buildings, infrastructure, and other capital projects and makes recommendations to City Council, in order to move the implementation of their project recommendations forward.

Benefits to the Community, Students and University

Because the EPICS team and the partnership with the community are both in early stages, benefits to the three main constituency groups, the community, students and university, have been identified through interviews and qualitative assessment. An informal survey was sent to

members of the RCSC (n= 11), and students on the team (n=4) were interviewed. The following sections include all of the comments returned in response to the informal surveys. There are, as yet, no negative responses to the project or substantive suggestions for improvement. A more formal educational assessment will be performed at the end of the semester as part of an overall assessment of the new EPICS program on campus.

Benefits to Community

What do you think are the benefits of the partnership with the student design team are for Rapid City?

By partnering, we have the advantage of their expertise in areas where we would be spending additional city funds to get the same services accomplished. This also provides a way for the students to work outside the school environment to solve problems they may encounter in their future careers or studies.

This can only strengthen the relationship between the City and SD Mines. The City also profits from the team's focus on providing an evaluation and strategy to make the city administration building more efficient. The city can also use the teams report as a template to save money throughout all the City's buildings with the end results of savings the citizens of Rapid City their tax dollars.

The city will get free services that could potentially save the municipality money and help it become more sustainable. If the city starts to lead the way in sustainable practices the people in the community will be more exposed to sustainability and start to see the value in it. This could lead to the people in the community wanting to live in a more sustainable way. The community will benefit from this partnership because they could see savings on taxes or at least no tax increases to cover increased cost. The potential money saved could be used in other areas of the city budget that are facing cuts. If the partnership continues to grow the community could benefit from other findings that will make the community a more enjoyable place to live and improve the quality of life. More importantly this partnership will also be providing an opportunity to students to work on real world issues with real situations. It will also provide them the opportunity to work with professional within the city. These experiences will prepare them for the market place and help them be productive members of society after they graduate. This is excellent hands on training for the students.

I think the primary benefit is the Rapid City community demonstrates their support of students attending SD Mines. We encourage students to participate in the community while attending school in Rapid City. We received a good evaluation of a real energy savings opportunity for a City building. Hopefully it also encourage the students to look for opportunities in the South Dakota area.

I feel that this partnership is beneficial to both parties. With the students they are getting valuable hands on experience in surveys that could be directly pertinent to their desired career fields. The committee is able to have real presentable data to show the city how certain changes can affect their bottom line, and if the city acts on purposed changes then ultimately the city benefits as well.

Do you feel that this partnership and the students are helping to attain the committee's goals? If so, how?

Their work was very relevant to a lot of the goals on Rapid City's Comprehensive Plan. Since the RCSC's goals are to mirror that plan, it was a good partnership.

Yes, a large part of our committee's focus is to guide the city towards a more sustainable strategy.

What they presented in just the energy audit performed at the City Offices Building has created a path towards sustainable goal fulfillment for the RCSC as well as the City as they move forward.

This partnership and the students are directly in-line with the committee's goals. In fact, one of our strategic goals is to promote energy efficiency throughout the City buildings and the City. The first project the students did was an energy audit on the City/School Administration Center (CSAC) building. This building houses the city council meetings amongst many other city departments and employees. The students presented to the City Council and provided many suggestions for lower the amount of energy being used. They also found a potential savings of \$200,000 over a 16 year period (life of a L.E.D) for switching to L.E.D lighting.

The students helped the committee achieve several goals. The City Council now has a good idea of potential benefits we offer the City through supporting the EPICS. We received great press coverage from the local newspaper and TV stations highlighting the presentation. Last but certainly not least, the design team helped demonstrate how the community can save energy.

The work of these students is giving the Sustainability Committee more fire power when it comes to achieving their chosen goals. As membership in the committee is voluntary and mostly full time working adults having students with time to gather data, take building surveys, put on these well thought out presentations to the City Council really allows for more persuasive power than we might have normally.

Benefits to Students

The Hardrocker Sustainability team members were interviewed to evaluate their opinions on the community benefits of this partnership and projects. The following summarizes the students' responses to the interview questions.

How do you feel that your experience working on this team, with input from professionals in the community, has helped prepare you for your engineering career?

I think that this experience is invaluable for my career and for my future. Most engineering is now team-orientated, so the more exposure to a team atmosphere, the better. Also having exposure to professional engineers is amazing – sometimes while being a student you are cutoff from the “real” world and having those connections will help you better your understanding of what is available after graduation and helps with communication with those individuals. Already this experience has helped me with getting job offers, as companies are looking for those qualities in engineers.

I believe that this class has helped me bridge the gap between my knowledge gained as a student and the skills I will need as an engineer. It has provided a better understanding of what I could do as an engineer.

My experience with this team has taught me a lot about how well-organized teams function and how to prepare a presentation for a large audience.

Do you think that you have experienced any unique benefits from broader community involvement and input from community members outside of the university? If so, please describe.

I think that being able to be a part of a community really shows you how important engineers are in society. Being a part of this team has expanded my horizons and has rounded me out as an engineer in general. Now that I am starting my Senior Design, the resources and experience I have gained has helped enormously.

I believe I have gained a valuable network of helpful people who are willing to provide assistance. I believe it has shown me that there are individuals in every community who want to make it a better place. I believe that when I graduate, it will be important for me to find a community of people who are willing to spend time to improve their communities.

Being directly involved with the community has given a unique perspective to approaching problems. This community-driven perspective is very conducive to customer satisfaction on any project.

Benefits to the University

There has been significant, highly positive press coverage of the team in print (RCJ 2018), and on local new stations (e.g. BHF 2018). Following the team's presentation to the city council, press coverage of the event included a quote from the university president, *"This is a fine example of SD Mines' students having a positive impact on the community through our EPICS program. These kinds of community projects give our students a chance to use their science and engineering education in real world applications that matter."*

Conclusions

Engineering and science service-learning programs and projects can improve relationships between universities and communities and tackle problems that might otherwise not have the funding or expertise to be solved by an individual entity. While the teams in the EPICS@mines programs are still evolving, the partnership between the Hardrocker Sustainability team and the RCSC provides a case study that demonstrates that there are benefits to the community partner, the university and the students. Students provide technical expertise and manpower, and gain design skills, professional development and mentoring from community members and professionals. The community benefits, not only from the project savings itself, both economically and environmentally, but also from the excitement of better connecting the community to the university, energizing members of the RCSC in advancing their strategic priorities, and building substantive relationships for future work. The university also benefits from improved ties to the community and positive public relations. Finally, the community itself benefits from cost saving measures and reduced environmental impacts associated with reduced energy demand. There is also the potential for numerous future benefits for all parties as diverse teams of students, academics, civic leaders and business leaders collaborate to improve the community through EPICS projects.

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