

Service-Learning in Engineering Through K-12/University Partnerships: Reflections from Five Years in the Trenches

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Abstract

Service-learning has the power to transform K-12 and higher education and local communities. This paper details three suppositions about service-learning and community action based on experiences working with K-12 and higher education: (1) service-learning works best when it covers an overarching theme, (2) multiple models for working with K-12 schools are useful, and the choice of model(s) should be based upon the needs articulated by the K-12 school and community, and (3) new models to integrate corporate giving with community action are needed because funding is an integral part of the process. The model of a K-12 school as a local center for community action can be critically important for ensuring the future success of the public school system and the surrounding community through hands-on, community-based teaching and learning.

Foreword

It is with pleasure that I write this paper to the Ernest Lynton section of the *Journal of Higher Education Outreach and Engagement*. The late Dr. Lynton is an inspiration to me because of his commitment to education and service and the recognition that buy-in from the public, university, and business communities is paramount. I am especially appreciative of Dr. Lynton's focus on community outreach because as a fellow science/engineering faculty member, I can attest to the theoretical emphasis placed on service to society and the lack of actual, explicit work done in this area with respect to our disciplines. Dr. Lynton's work provides an excellent example and foundation for educators in the sciences and beyond to integrate community outreach and scholarship, and to be recognized within the academy for such work.

I would like to acknowledge my long-term service-learning collaborators and mentors, including Judy Bethly, Carol O'Neil, Deborah Normand, Becky Ropers-Huilman, and Jan Shoemaker. Thanks to teachers Lynn Hathaway and Cristina Sabliov for critically reviewing this paper.

Introduction

I became an engineer because I wanted to make the world a better place. What I found as a student and a professional is that engineering often boasts of serving society, but we usually serve clients and capitalism, entities that may be far removed from service to society. A colleague¹ and I often spoke about how we might transform engineering education from its current state, which we sometimes refer to as “the creation of highly skilled barbarians,” to a liberal, holistic approach that truly and tangibly serves society.

During the 1997–98 school year, I became acquainted with and began using service-learning. This pedagogy has transformed my teaching because with it I can show engineering students that there is more to the discipline than numbers, and that an understanding of the social and historical aspects of people, culture, and society is central to the design process and critical to the success of democratic society.

I’ve used service-learning in several courses, but my primary focus is with Biological Engineering (BE) 1252: Biology in Engineering, a freshman-level design course in which students are introduced to engineering and the design process. I initiated a service-learning approach in this course because I wanted students’ first experiences with engineering to address a community need in a way that would involve working with community partners to develop communication, citizenship, and teaming skills as well as technical know-how.

I have chosen to concentrate my efforts on K–12 public schools in Baton Rouge, Louisiana, because “white flight” has drained financial and social capital from the parish public schools. In addition, the public schools bear enormous pressure from the state legislature and the public to improve test scores. The inequities inherent in this system are analogous to wider societal problems involving racial, educational, and economic disparity. It is an excellent real-world situation in which to work with community partners to address community needs through academic service-learning activities that equally empower the community and the students. My goal is to work with K–12 students, teachers, and administrators to provide a safe, accessible playground to every child in public school in the city of Baton Rouge. This represents a formidable challenge, as there is no dedicated budget for playgrounds in the school system.

There is a wealth of published literature regarding service-learning in K-12 and higher education settings. My purpose in this paper is not to detail methodology, to present in-depth research, or to provide testimonials in the hope that current and future teachers will adopt this pedagogy, though some of all of this is briefly presented. Readers are encouraged to consult the service-learning resources in the references for general information on service-learning; those interested in service-learning in the engineering profession can consult the resources on service-learning and engineering education listed in the references.

My purpose in this paper is to provide a somewhat philosophical framework based on five years of working "in the trenches" with the K-12 public school system. I will present this framework in the context of three suppositions, and will detail specific information in the respective sections.

The three suppositions are:

- ◆ Service-learning works best when it covers an overarching theme.
- ◆ Multiple models for working with K-12 schools are useful, and the choice of model(s) should be based upon the needs articulated by the K-12 school and community.
- ◆ New models to integrate corporate giving with community action are needed because funding is an integral part of the process.

I believe that service-learning is a critically important means for ensuring the current and future success of the public school system through hands-on, community-based teaching and learning.

This information is intended to be applicable to a multiplicity of groups. Because I have worked extensively with playgrounds, the examples that I present are primarily focused on this work. The overall framework and recommendations presented in this paper apply to those who wish to complete service-learning projects in any discipline, however.

Supposition 1: Service-Learning Works Best When it Covers an Overarching Theme

I first learned about this concept from Kerrissa Heffernan, who detailed this idea during a talk about her book *Fundamentals of Service-Learning Course Construction* (2001). My initial reaction

was that this idea could narrow creative projects throughout disciplines with regard to service-learning. Upon listening to her explanation, I believe that this idea has a great deal of merit. According to Heffernan, the University of California, Los Angeles, decided in the 1980s that all university outreach into the local community should take one theme: that children raised in the area adjacent to the UCLA campus² should have access to the university as prospective college students. Thus, all UCLA outreach centered on developing and executing enrichment programs for K-12 students through enhancing the K-12 curriculum, introducing the idea of college through interaction with college students, and providing open access to the campus. Heffernan reported that presently, numerous local students are admitted to UCLA as a result of this overarching theme.

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introducing the idea of college through interaction with college students, and providing open access to the campus. Heffernan reported that presently, numerous local students are admitted to UCLA as a result of this overarching theme.

I believe that choosing such a theme is critical. The challenge is to make the theme broad enough to accommodate the efforts of disparate disciplines, and sufficiently specific to unify these efforts into a concerted force for community action.

I posit that overarching themes for K-12 service-learning programs should be developed by the school and the local community as equal partners working toward a common goal. Ira Harkavay, the director of the Center for Community Partnerships at the University of Pennsylvania, has talked about the concept of K-12 schools as centers of local community action. Numerous K-12 schools in the Philadelphia area have worked through the West Philadelphia Improvement Corps (WEPIC) to address community issues (*James and Hill 1998*). The overarching theme in this case was health issues; while Philadelphia has some of the finest medical care and cutting-edge medical research and technology available in the United States, the surrounding community lacked access and awareness regarding health care issues. Turner Middle School was part of the WEPIC effort to address health issues by focusing on preventative health care. At Turner, students teach

each other and the community about preventive health care and nutrition; they run a store that sells fruits, vegetables, and herbs, and develop teaching materials for the community. K-12 teachers changed their curriculum in response to the community focus, and all subjects are unified in their approach on community action and education on health issues.

The promise of service-learning is to further democracy by providing a fair, just, equitable society one community at a time. Service-learning programs should have an overarching mission to effectively address community issues through concerted effort by all members of the community. I believe that for this mission to be most successful, the entire community should be involved in determining the community issues to be addressed. K-12 teachers, students, and administrators can take a key role in this process as members of the community, with the concept that K-12 schools will be centers of local community action.

Supposition 2: Multiple Models for Working with K-12 Schools are Useful, and the Choice of Model(s) Should Be Based upon the Needs Articulated by the K-12 School and Community

After the overarching theme and community issues have been addressed, the service-learning models that will be employed by the school to address these issues should be critically considered. The K-12 teachers will be at the center of this effort, as they are the curriculum experts. In this section, I will use my experiences to illustrate the ways in which K-12 teachers and students (sometimes working with college teachers and students) have integrated a service-learning project into curriculum. I will then discuss ways in which K-12 teachers can be best supported in their efforts to establish long-term, meaningful service-learning programs that address community needs. Finally, I offer two suggestions to K-12 teachers on service-learning projects.

My programmatic theme for service-learning is that every child attending public school in Baton Rouge, Louisiana, shall have access to a safe, well-designed playground. My quest in this goal has been driven to a large extent by available funding avenues (see supposition 3 for funding issues). Because of the wide variety of funding avenues and respective requirements, I have used numerous models in terms of working with K-12 teachers and schools. These models include the following:

Formal educational models:

- ◆ Using principles of playground design to enhance the math and science education of K-5 students (worked with math and science magnet teachers to develop hands-on activities for the math/science magnet program at an elementary school). Subjects include:
 - Learning shapes and colors
 - Conducting measurement experiments (heights of slides and swings, thickness of surfacing,³ etc.)
 - Analyzing the environmental impact of the type of surfacing
 - Determining “use zones” (appropriate areas of surfacing under and around play equipment to break falls)
 - Determining the placement of equipment on a playground
 - Evaluating safety issues (critical fall heights, unimpeded “sight lines” for supervisors, measurements to determine that appropriate safety conditions are met, etc.)
 - Examining the importance of trees, grass, and water in playgrounds
 - Other activities⁴.
- ◆ Using the playground as an art theme with students working on these issues through art class (working with art teachers and community artists).
 - Drawing a “dream playground”
 - Creating murals as part of the playground (on walls, on concrete slabs for games/basketball/creative play)
 - Creating tiles that become a formal part of the playground (can be built into benches, memorial areas, etc.).
- ◆ Using social studies to create a “theme” playground that reflects the unique aspects of the community.
 - Interviewing community members and creating oral histories to determine community theme(s)
 - Presenting ideas to the community and making decisions together
 - Planning, organizing, and executing fund-raising drives for the playground.
- ◆ Using English and language classes to write, speak, and reflect on exercises involving the playground.
 - Keeping journals on project progress (in one or more subjects)

- Preparing proposals to fund the playgrounds (they can also orally present to local funding agencies).

Nonformal educational model:

I have been involved in a nonformal science education project funded by the National Science Foundation.⁵ The objective of this program is to develop an engineering curriculum for students nine to nineteen years old that will be cooperative, community-based, and geared toward providing interest in and access to science, mathematics, engineering, and technology fields to girls, minorities, and rural youth. This curriculum will be disseminated nationally through 4-H. Preliminary results have shown that students are most interested in playgrounds and zoos in a science, math, and engineering context regardless of gender, race, or geography (rural versus urban). An initial curriculum for playground design is now in the design phase.

Playground design has broad appeal and can cut across all disciplines. The design and construction of a successful playground at the school is dependent on a number of factors, including:

- ♦ The buy-in and involvement of public school teachers, students, administrators, and the community
- ♦ The creation of activities and lesson plans that match the service-learning project with the current, established curriculum (or possibly the creation of new curriculum)
- ♦ The funding to complete the project.

Because tying the service activity to the learning objectives is critical, the K-12 teachers are key players in this area.

I posit that in order to provide K-12 teachers with the tools to build community through service-learning projects, it is necessary that they be provided with resources and incentives for the extra work entailed in this approach, including but not limited to:

- ♦ Emphatic support from higher administration.
- ♦ Flexibility in terms of creativity with curriculum, for example, presenting learning objectives in the context of a community issue.
- ♦ A minimum of "red tape" with regard to hands-on, community-based activities, for example, paperwork involved with field trips, consent issues, and liability issues (administration can do as much up-front work as possible to minimize this load

on the K–12 teacher), and the formation of significant ties with community groups such as universities, non-profits, or other public schools.

- ◆ Salary supplements for teachers who have shown initial interest in incorporating service-learning or sustained record of excellence in service-learning. One possibility could be providing summer salary for planning a community-based service-learning curriculum in a given subject area. Others could involve summer salary and/or salary supplements for getting other teachers started with this pedagogy (for experienced teachers).
- “K–12 teachers are central to the success of the service-learning vision of public schools as community action centers.”*
- ◆ Free registration for workshops to enhance teacher professional development (for example, an annual workshop for Louisiana science teachers statewide has enabled the sharing of service-learning projects in science).
 - ◆ Grant support for executing projects of community importance.

I will close this section with two things that I have learned through experience. The first is that local policy changes are sometimes driven by service-learning projects.

I believe that safe, accessible playgrounds are extremely important for all children, as they promote social, physical, and mental growth, and combat obesity (*Sutterby and Frost 2002*). I was concerned that some of the K–12 schools I worked with had no recess or very short recess (5–10 minutes) for students. The major reasons cited were too little time for play (thus more time spent on academics to prepare for testing), the lack of a suitable playground, or a multiplicity of behavioral problems during recess (hence its elimination). I am happy to report that in every school I’ve worked with, policy changes have occurred because of the construction of a new playground, including:

- ◆ Progressing from no recess to 15-minute recess for every child
- ◆ Progressing from short to extended recess
- ◆ A decrease in behavioral problems during recess
- ◆ Fewer children at recess at one time and better supervision (children must rotate through high-interest equipment like swings).

I believe that this concept is an important one to keep in mind when designing and executing service-learning projects in conjunction with the community: that the situation, and possibly the community, will tend to change in response to your project.

The second point is that *unintended consequences are part of the process* but can be minimized by planning carefully, working closely with your community partner, and not being afraid to have a true conversation. Perhaps another way of putting this is that service-learning is as much about process as it is about outcomes. I am convinced that teachers learn as much as students through the service-learning process; making "mistakes" is essentially a given, but learning to work with these issues is critical for the true establishment and growth of democratic society.

An example may illustrate this point. My students worked very hard to design a playground for "the whole child," which involved strategic placement of benches, green spaces, and quiet places to promote intimate conversation, thoughtful reflection, and imaginative activities. Approximately six months after the construction of the playground, we visited the school where the playground was constructed. A teacher told us: "We're so glad you put those benches there, we make kids sit there when they don't behave well on the playground, and it's a very effective punishment because the only thing that they do is sit there and watch their classmates having fun!" Thus, items that we designed for a specific purpose were being used in a completely different way than we intended.

K-12 teachers are central to the success of the service-learning vision of public schools as community action centers. Their dual roles as teachers and community activists are critical, and their resulting creative efforts must be supported by upper administration and the wider community. Another critical success factor is economics, so much so that it is worthy of discussion by itself.

Supposition 3: New Models to Integrate Corporate Giving with Community Action are Needed because Funding Is an Integral Part of the Process

Most service-learning practitioners believe that service-learning addresses community-based problems and issues, and will serve the citizens, government, and/or the nonprofit sector accordingly. Though I believe this to be true, I also acknowledge that the funding necessary to make seed change in a community is often greater than funding avenues provided by these sectors. I

further believe that because corporations depend on the existence of citizens, government, and the nonprofit sector to survive, they can and should help to fund service-learning projects.

Many corporations are presently involved in such efforts, and while these efforts are laudable, many come rife with concerns in the view of this writer. The current paradigm is that in exchange for support dollars, we give corporations advertising, sometimes exclusive advertising. For example, in return for money to support educational programs, soft drink companies may receive exclusive rights to provide beverages at K-12 schools. I posit that working to build strong, vibrant, democratic communities is payment enough for local corporations, who profit from the resulting strong public sector. My assertion is that we shall hold corporations to ethical standards by decoupling advertising and community action.

Experience leads me to add the following points:

- ♦ K-12 teachers have access to numerous grants, but most are in the funding range of \$500-\$5,000. Seed change doesn't occur in communities with budgets on the "bake sale" scale. Teachers can write numerous grants to raise substantial sums of money, but this approach represents great time and effort, and coordination of funding agencies. I propose that corporations create service-learning grant programs with higher funding ranges in order to make the funding level commensurate with the magnitude of the service-learning project.
- ♦ Numerous funding opportunities exist to initiate service-learning programs, but few provide for ongoing expenses after the program has been established. I propose that corporations fill this largely unaddressed issue in current funding structures by providing perpetual operating support for successful service-learning programs at local K-12 schools.

Conclusions

Societal problems are complex, and K-12 schools, which are concerned with the development and creation of thoughtful citizens, are in an excellent position to address these issues on a local scale. In order to carry out the vision of K-12 schools as centers for community action, K-12 teachers must work with the community to:

- ♦ Develop an overarching service-learning mission based on addressing key community issues

- ♦ Integrate service-learning into curriculum with emphatic support and resources from upper administration and the community
- ♦ Address potential funding issues to effectively put service-learning programs and products into place on a permanent basis.

Ira Harkaway has stated that “universities, particularly urban universities, have moral and intellectual obligations . . . to their surrounding communities” (*James and Hill 1998*). I believe that K–12 schools are equally obligated to their local communities. I further believe that corporations have equivalent moral and business obligations to their surrounding communities. It is only through the forging of new corporate service funding models that K–12 schools and universities can fully meet their moral and intellectual obligations.

Endnotes

1. Ann Christy, associate professor, Food, Agricultural and Biological Engineering, the Ohio State University.

2. The area immediately adjacent to the campus was a severely distressed community.

3. Surfacing is material placed under and around play equipment to break falls, for example, mulch, sand, crushed tire, and rubber mats.

4. Numerous methods for integrating math and science through playgrounds are given in the book by Jan Ham, *Designing Playgrounds*, Menlo Park, Calif.: Dale Seymour, 1998.

5. Reeder, R., R. Tohrmoelen, and M. Lima. Exciting girls, minorities and rural youth through engineering programs in 4H. National Science Foundation Planning Grant, Nonformal Science Education. \$47,900 (2003–2005).

References

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- James, D. W., and A. Hill. 1998. The growing role of urban four-year universities in service-learning, school reform, school-to-work and community change: A forum brief. American Youth Policy Forum. <http://www.aypf.org/forumbriefs/1998/fb052298.htm>.
- Sutterby, J., and J. Frost. 2002. Making playgrounds fit for children and children fit on playgrounds. *Young Children* 57(3): 36–42.

Service-learning resources:

- American Association for Higher Education. Service-learning in the disciplines. http://www.aahe.org/service/series_new.htm.
- Learn and Serve America. <http://www.learnandserve.org/>.
- Learning to Give. <http://www.learningtogive.org>.
- Michigan Journal of Community Service Learning. <http://www.umich.edu/~mjcs/>.
- National Service-Learning Clearinghouse. <http://www.servicelearning.org>.
- National Youth Leadership Council. <http://www.nylc.org/>.
- Rappoport, Ann L., and Sharon B. Kletzien. Kids around Town: Civic education through democratic action. <http://pa.lwv.org/kat/intro/demaction.html>.

Service-learning and engineering education resources:

- Lima, M. and W. Oakes. 2004. *Service-Learning: Engineering in Your Community*. Wildwood, MO: Great Lakes Press.
- Oakes, W. 2004. *Service-Learning in Engineering: A Resource Guidebook*. Providence, R.I.: Campus Compact Press.
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About the Author

Marybeth Lima has been at LSU since 1996; she has taught BE 1252 eight times, and the collective efforts of the community and students in this course have resulted in the design and construction of six playgrounds, an outdoor classroom, a butterfly garden, and a bird sanctuary. Dr. Lima's research interests include biological engineering, engineering education, and the practice of engineering as it relates to social justice and change. She has been nationally recognized for her work in service-learning in engineering by the American Society of Agricultural Engineers and the American Society for Engineering Education. In 2004, she received the Gulf South Summit Award for Outstanding Contributions to Service-Learning in Higher Education, was a finalist for the Thomas Ehrlich Faculty Award for Service-Learning, and received an Honorable Mention for the Ernest A. Lynton Award for Faculty Professional Service & Academic Outreach. Dr. Lima is the co-author of *Service-Learning: Engineering in Your Community*, a textbook for engineering students completing service-learning projects within a community setting. This book was published by Great Lakes Press in 2004.