AC 2011-2389: COMMUNITY ENGAGEMENT IN BIOLOGICAL & AGRICULTURAL ENGINEERING

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Community Engagement in Biological & Agricultural Engineering

Abstract

The discipline of biological & agricultural engineering (BAE) has contributed significantly to the mechanization and efficiency of agriculture, the production of food and fiber, and the distribution and control of water during its 100+ year history. The work of biological and agricultural engineers through state Agricultural Experiment Stations and Cooperative Extension has ensured that the problems facing agriculture are solved using an applied research model in which the direct beneficiaries of the research (usually farmers) have input in the direction of such research. Although our discipline and our work have been successful, challenges in the discipline remain due to our society becoming increasingly urban with fewer people involved in agriculture, and with decreasing funding and increasing accountability for our research and outreach work. I believe that our discipline can continue to offer solutions to timely problems in rural and urban environments and can continue to flourish in national and international arenas by embracing community engagement. Because the traditional focus of biological and agricultural engineering has been mission oriented research geared toward direct recipients (users) of this research with the input of this constituency, our discipline is poised to work within this context to continue research, teaching, and outreach activities of relevance to pressing societal problems. I suggest that we consider several paradigm shifts that will position our discipline for future success:

1. That we extend the focus of our outreach efforts beyond those directly involved in production agriculture
2. That we use teaching as a vehicle for engaging with community (in addition to research and outreach)
3. That we move toward Boyer's model of the scholarship of engagement, with seamless transitions among research, teaching, and outreach activities.

This paper provides background information on community engagement, including principles of community-based design, discusses the aforementioned paradigm shifts in detail, and provides recommendations for BAE professionals to implement such shifts.

Introduction

The scholarship of engagement. In 1990, Ernest Boyer, the President of the Carnegie Foundation, published a book entitled "Scholarship Reconsidered: Priorities of the Professoriate[1]," which examined faculty activity, reward, and time structures at the university. He called for a new model regarding faculty scholarship with four areas: (1) The scholarship of discovery (pursuit of inquiry and creation of new knowledge), (2) the scholarship of teaching (transmitting, transforming, and extending knowledge), (3) the scholarship of application (how knowledge can be applied to social issues of the times), and (4) the scholarship of integration (making connections across disciplines and advancing knowledge through synthesis). Boyer further refined his paradigm in a 1996 article entitled *The Scholarship of Engagement*[2], in which he states, "Still, our

outstanding universities and colleges remain, in my opinion, one of the greatest hopes for intellectual and civic progress in this country. I am convinced that for this hope to be fulfilled, the academy must become a more vigorous partner in the search for answers to our most pressing social, civic, economic, and moral problems, and must reaffirm its historic commitment to what I call the scholarship of engagement."

Nationwide, universities have embraced the scholarship of engagement, and much literature has been generated on the scholarship of engagement in specific disciplines as well as in university-wide and national contexts[3]. Developments in this area have been underscored by The Carnegie Foundation for the Advancement of Teaching. Recently, the Carnegie Foundation created the Community Engagement Elective Classification[4] as follows:

"The classification for Community Engagement is an elective classification, meaning it is based on voluntary participation by institutions. Whereas the Foundation's all-inclusive classifications involve secondary analysis of existing national data sources available for all institutions, elective classifications involve additional data collection and documentation, with substantial effort invested by participating institutions. Elective classifications enable the Foundation's classification system to recognize important aspects of institutional mission and action that are not represented in the national data.

Because of their voluntary nature, elective classifications do not represent a comprehensive national assessment: an institution's absence from the Community Engagement classification should not be interpreted as reflecting a judgment about the institution's commitment to its community.

Community Engagement

Describes the collaboration between institutions of higher education and their larger communities (local, regional/state, national, global) for the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity.

In 2006 and 2008, the classification included three categories:

Curricular Engagement includes institutions where teaching, learning and scholarship engage faculty, students, and community in mutually beneficial and respectful collaboration. Their interactions address community-identified needs, deepen students' civic and academic learning, enhance community well-being, and enrich the scholarship of the institution.

Outreach & Partnerships includes institutions that provided compelling evidence of one or both of two approaches to community engagement. Outreach focuses on the application and provision of institutional resources for community use with benefits to both campus and community. Partnerships focuses on collaborative interactions with community and related scholarship for the mutually beneficial exchange, exploration, and application of knowledge, information, and resources (research, capacity building, economic development, etc.).

Curricular Engagement and Outreach & Partnerships includes institutions with substantial commitments in both areas described above." (http://classifications.carnegiefoundation.org/descriptions/community_engagement.php).

Since the Carnegie classification for community engagement was developed, 118 universities have adopted this classification, including many land grant universities (full list available at url in previous paragraph).

Because the traditional focus of biological and agricultural engineering has been mission oriented research geared toward direct recipients (users) of this research with the input of this constituency, our discipline is poised to work within this context to continue research, teaching, and outreach activities that are relevant to pressing societal problems. I posit that the discipline of BAE is positioned to lead the engineering profession with respect to community-based engineering design. Adhering to the principles of community-based engineering design (discussed in detail below) will enable the engineering profession to bring its perspective and voice to the community-engaged scholarship movement.

Principles of community-based engineering design. Community-based engineering design involves the community and its stakeholders in every stage of the design process, including definition of the problem to be solved, gathering information, generating preliminary design concepts, evaluating and selecting a design concept, and implementing the design. The community is an active participant in every step of the design process and the interests of the community are the driving force behind the design process to ensure that the artifact produced is a reflection of the unique community it will serve.

In engineering design, we talk about meeting customer or client needs and how to meet those needs through a design. In community-based design, we use the term community partner instead of customer or client, because the customer or client implies a one-way relationship in which the engineer works for the client or customer. In community-based design, there is an equal partnership between community stakeholders and the designer; they work together through every phase of design. This two-way exchange is more accurately defined as a partnership, thus the term community partner. Principles that guide community-based engineering design are as follows.

- **The community's needs and desires drive the design process.** Because the design will directly serve the community, the community should have primary say regarding the important functions and aspects of the design. For example, if the community's top design priority was a playground, you would not design an amusement park in response to this priority. Part of the community-based design process involves working with the community partner to determine the community's needs and desires in an organized, comprehensive way.
- **Decisions are made by the community and/or in conjunction with the community.** Not all members of the community will be engineers, but decisions in the design process such as form, function, performance, use, etc., should be made by the community stakeholders. The engineer should take the lead on technical matters like safety standards, identifying material selection parameters,

and so on, but the community should be familiar with the design process and should be presented with (and make) design decisions.

- **The design process is transparent and flexible.** The design process should be explained and illustrated to community members because they are the primary stakeholders in the process. The expertise and knowledge of community stakeholders is critical to the design process; you will capture this information, including the nuances that make a good design great, if the design process is transparent. Flexibility is also key because the community environment is dynamic; new facts may emerge and become the driving forces in the design as community stakeholders and engineers evolve their thinking and change their minds during the process.
- **Everyone agrees on the deliverables at the outset.** Since the community is the ultimate user of the design, the stakeholders should agree on what is to be delivered. One common pitfall of community-based design is miscommunication between the engineer and the community partner involving the deliverables. For example, the engineer might think that the final deliverable is a design on paper, while the community partner thinks that the final deliverable is a prototype of the artifact designed. Open communication involving deliverables and budgetary limitations is critical for successful collaboration. Keep in mind that it is also common for the deliverables to be renegotiated during the process due to the dynamic nature of budgets and the creative process.

Paradigm shifts

Given that community engagement is a burgeoning area of interest (and necessity) in higher education, and that BAE is well positioned to advance community-based engineering design, I suggest that we consider several paradigm shifts that will position our discipline for future success:

1. **That we extend the focus of our outreach efforts beyond those directly involved in production agriculture**

This change is already underway in the more biological aspects of our discipline and in extension programs directed at urban audiences, such as 4H and obesity prevention programs geared toward children and communities residing in urban areas respectively. I am not suggesting that we drop our focus on agriculture, I am suggesting that we expand our focus in response to changing demographics and societal issues which we have not considered holistically, for example, poverty and climate change.

2. **That we use teaching as a vehicle for engaging with community (in addition to research and outreach)**

Our model has tended toward transferring research to our clientele through extension, and using teaching to instruct students. We can re-frame our teaching efforts to directly connect our students with our community partners, in effect, creating a "student as extension agent" model with one important difference: that our community partners are also extension agents and work as equal partners. The transfer and sharing of knowledge between students and community partners to leverage assets of both groups is at the core of the scholarship of engagement.

For example, Engineering Projects in Community Service (EPICS) is a national service-learning model for engineering students that began at Purdue University in 1995. Vertically integrated teams (consisting of engineering students of all ranks from first year to senior students) partner with a local community partner to address a complex community need. Examples include:

- Students work with the university dairy farm to design and build a constructed wetland to remediate waste produced by the farm
- Students collaborate with members of a local community to develop an environmental site plan to address issues raised by the construction of a landfill in the community
- Students work with the Dean of Students Office to design classroom furniture for college students with physical disabilities or devices to assist students with visual or hearing impairments
- Students collaborate with Habitat for Humanity to test the strength of wood beams in new or renovated houses, and to develop floor plans and designs for new houses
- Students work with local zoos to design new habitats for captive animals, a multimedia learning/education center, and a new layout for the existing zoo space

Nationwide, 20 schools are "EPICS Universities," meaning that they use the EPICS model to engage engineering students with their local communities to address critical community issues (https://engineering.purdue.edu/EPICSU/).

3. **That we move toward Boyer's model of the scholarship of engagement, with seamless transitions among research, teaching, and outreach activities.**

This integration can be accomplished at the project level, department level, or institutional level. For example, at the project level, I teach a service-learning course to biological engineering freshmen, in which they partner with local public elementary school children, teachers, and administrators to design playgrounds at the schools. College students learn about design in class and at the site, learn about play from the experts (children), and learn about the school environment from administrators and teachers. Teachers and administrators learn about playground safety from college students; elementary school students learn about design from college students. College students, community members, and faculty members work together to write grant proposals and to fundraise to garner funds to build the playgrounds; when such funds are secured, they volunteer together to build the playground. In this model, teaching is extended to outreach and vice versa; everyone is an extension agent of sorts. This model

has also resulted in a number of research questions and projects undertaken by faculty, students and community partners, for example: what happens to arsenic in pressure treated wood on playgrounds? Can sugarcane bagasse be used as a playground safety surfacing material? Can a "play curriculum" be developed that will enable children to meet national physical education standards while playing on playgrounds? If so, does it work?

One institutional example of the scholarship of engagement includes the University of Georgia's Archway Partnership, whose mission is to collaborate with communities to address economic development issues using the assets of the university, the community, and the state. Another example is Michigan State University's Office of University Outreach and Engagement, whose keywords are: "scholarly, community-based, collaborative, responsive, capacity-building, and for the public good."

Collectively, these three paradigm shifts, in the context of higher education's focus on community engagement and our historical involvement with our constituencies, can lead to BAE continuing to serve society by addressing issues at the intersection of biology, agriculture, and engineering.

Recommendations

Although BAE is well positioned to contribute to the scholarship of engagement and the solving of pressing social problems, many of us are not aware of the "other players" already in the trenches in community engagement efforts. The recommendations in this section are intended to provide information to enable BAE practitioners to "plug in" to this community seamlessly and efficiently.

1. Reach out to connect, learn, and contribute

Many partnerships to address critical community issues already exist locally, regionally, and nationally. Connecting with these networks will enable faculty to "learn the ropes" with regard to community engagement and can provide a springboard for putting engineering into action. At your university, check for offices such as civic/community engagement, community university partnerships, outreach and engagement, or service-learning to get connected. Research/teaching faculty can also engage more closely with extension efforts, especially extension efforts geared toward "non-traditional" audiences such as urban communities. BAEs have skills in grant writing and problem solving that are directly transferrable to addressing critical community issues in partnership with community members.

2. Involve your students

Just as the current generation of college students is more technically savvy than most BAE faculty, this current generation of students is far more connected to community than BAE faculty tend to be. Almost all current college students completed mandatory community service hours to graduate from high school. When asked, most students say that they are studying engineering to better serve society. Explicitly connecting our classes to our communities better serves our students (enhanced educational experience),

provides them with the connection between engineering and serving society that they are interested in, and better serves our community.

Organizations and design concepts that you might look at when considering involving students include:

- Engineering Projects in Community Service[5], https://engineering.purdue.edu/EPICS
- Engineers Without Borders, http://www.ewb-usa.org/
- Design for the Other 90%, http://other90.cooperhewitt.org/
- The Environmental Protection Agency National Student Design Competition: People, Prosperity, and the Planet, http://www.epa.gov/p3/

3. Start small and dream big

When undertaking a change in thinking or a shift in scholarly activity, be it teaching, research, or outreach, it makes sense to start with small, easily executable projects and build on the successes, challenges, and lessons learned from these projects. Once a community engaged scholarship program has been established, one can start thinking about larger impacts, for example, bigger projects, or themed projects around societal issues like poverty or technical issues like the National Academy of Engineering's Grand Challenges.[6]

Conclusion

The discipline of biological & agricultural engineering has a history of working directly with clientele on research and outreach efforts. This history strongly positions BAE as a player in the engineering profession and in multidisciplinary efforts to address societal issues through a community-based approach. I believe that three paradigm shifts could make BAE more effective as a discipline as we look toward the future: 1. That we extend the focus of our outreach efforts beyond those directly involved in production agriculture; 2. That we use teaching as a vehicle for engaging with community (in addition to research and outreach); and 3. That we move toward Boyer's model of the scholarship of engagement, with seamless transitions among research, teaching, and outreach activities. If we are able to connect to our respective university offices of community engagement to "learn the ropes" of this movement in higher education, and if we leverage our constituencies, especially our students, I believe that BAE will be well positioned to contribute to solving societal issues well into the future.

References

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