

University-Led Engineering Outreach to Adults: Public Engagement and Senior Adult Initiatives

Ashlee N. Ford Versypt*·†, School of Chemical Engineering, Oklahoma State University

Joel J. Versypt*, College of Engineering, Architecture and Technology, Oklahoma State University

Heather Gappa-Fahlenkamp, School of Chemical Engineering, Oklahoma State University

* These authors contributed equally.

† Correspondence: ashleefv@okstate.edu

Introduction

University-led engineering outreach is an important activity for extension efforts and for faculty interested in broader impacts of their teaching and research endeavors. In many universities, much of the science, technology, engineering, and mathematics (STEM) outreach activities are focused on K-12 students and/or educators. In this paper, we highlight engineering outreach geared primarily towards adults through public engagement and senior adult initiatives. First, we will describe benefits of engineering outreach to adults. Then, we will detail some examples from our university.

The benefits of higher education have been described as a two-dimensional matrix (Figure 1) where there are social and economic benefits to private individuals as well as the public or the general population (The Institute for Higher Education Policy 1998). The benefits of formal undergraduate and graduate education likely differ in scope than short-term outreach sessions designed to target adults outside of university classrooms; however, the perspective can be still useful when thinking of the numerous benefits such activities can provide.

	Public	Private
Economic	<ul style="list-style-type: none"> * Increased Tax Revenues * Greater Productivity * Increased Consumption * Increased Workforce Flexibility * Decreased Reliance on Government Financial Support 	<ul style="list-style-type: none"> * Higher Salaries and Benefits * Employment * Higher Savings Levels * Improved Working Conditions * Personal / Professional Mobility
Social	<ul style="list-style-type: none"> * Reduced Crime Rates * Increased Charitable Giving/Community Service * Increased Quality of Civic Life * Social Cohesion/ Appreciation of Diversity * Improved Ability to Adapt to and Use Technology 	<ul style="list-style-type: none"> * Improved Health / Life Expectancy * Improved Quality of Life for Offspring * Better Consumer Decision Making * Increased Personal Status * More Hobbies, Leisure Activities

Figure 1. Economic and social benefits of higher education to the general public and to private individuals (The Institute for Higher Education Policy 1998).

Here are just some of the benefits of engineering outreach for adults:

1. Educational outreach programs for adults, particularly senior adults, may have social, medical, and economic benefits for individuals (Bibel 2018).
2. A scientifically literate individual may make better-informed decisions regarding personal health, environmental stewardship, voting, and other areas that benefit society as a whole.
3. Engineering engagement with adults, especially with those who already have a relationship with the institution that leads the outreach efforts, can be a good supplement to the development work of the institution's alumni association and fundraising team.
4. Engineering outreach to adults can enable participants to be more productive in their current employment or caretaking positions or aid in scientific discovery as citizen scientists.
5. Educating adults of all ages may have a trickledown effect on STEM aspirations and career knowledge for the participants' children, grandchildren, and other friends and relatives.

Examples

In the remainder of this paper, we will briefly detail a wide array of specific examples of engineering outreach targeted to adults including events focused on legislators, activities presented to residents of retirement centers, a summer camp for elementary and middle school children and their grandparents, public presentation events such as Science Café and Research on Tap, open online courses and lifelong learning institutes, open houses, and extension.

Events focused on legislators

Most state and federal legislators have backgrounds in non-STEM fields (Congressional Research Service 2019). However, legislators are called upon to write and/or vote on legislation that deals with STEM policies, funding, and regulation, and those with some STEM training may make more evidence-based decisions (Westerman 2018). Our state has a number of opportunities for state governmental officials to interact with university students and researchers. During the Research Day at the Capital event, select undergraduate researchers from public higher education institutions from across the state presents their research projects in the rotunda of the state capital building to legislators, faculty, students, research administrators, and other guests. The event is open to the public. Additionally, state and federal legislators are periodically invited to tour university facilities including new or renovated engineering research and teaching spaces or to view student posters or design project demonstrations.

Activities presented to residents of retirement centers

A local retirement center has a program called N2O (Never Too Old) Innovators for senior adults to engage in design, entrepreneurship, and invention (Roach 2019). The group has toured our engineering hands-on undergraduate teaching laboratory and has interacted with interdisciplinary senior design teams and engineering and technology faculty. We are working with the program to partner with them on a senior design project to design, fabricate, commission, and test prototype kitchen cabinet systems to enable safer, more efficient access by individuals with mobility challenges that prevent them from effectively using standard systems.

Another community center in one of the author's hometowns has a weekly lunch for senior citizens. An outreach event was held during one of their lunches to demonstrate the science behind a variety of kitchen chemistry applications. The rural community is not located near a university, and there are not many STEM career opportunities for the local residents outside of the medical field. The event was designed to entertain, engage, and educate attendees on chemistry and engineering topics that they could share with their families and friends later when they encountered some of the same processes again in their own kitchens.

Summer camp for elementary and middle school children and their grandparents

The university alumni association hosts Grandparent University as an annual 3-day residential summer camp offered as two sessions each summer. Grandparent University is for legacies (children who have a parent or grandparent who is an active member of the alumni association) ages 7 to 13 and their grandparents or adult chaperone of their grandparents' generation. The camp is intended to be a fun-filled experience that actively engages kids in academics on campus while creating memories for grandparents and their grandchildren. The children and grandparent groups enroll in one of the "majors" offered and complete 6 hours of activities in that major during the camp. The classroom activities are led by university faculty, staff, and students. In 2019 the engineering offerings include architectural engineering, biomedical engineering, feel the energy (led by chemical and petroleum engineering faculty), and light-activated motorized boats (led by electrical engineering faculty). One of the authors has participated in this event three times.

Public presentation events

Science Cafés take place across the country and provide an opportunity for scientists and the public to meet in a casual setting for discussion (Science Café 2019). Our university's Science Café is a series of regularly occurring events that highlights interesting, relevant, and current scientific research (Science Café OSU 2019). Events provide opportunities for attendees to participate in lively and engaging conversations about science. Each Science Café features refreshments, a brief presentation by a scientist, and a period for questions and answers. The events are free and open to the public. No science background is assumed or required. Science Café is hosted by the university library and student organizations or community groups related to the topic of the event are invited to co-sponsor for advertising. Several engineering faculty including one of the authors have participated with talks on a variety of research topics. Faculty have collaborated on related topics to demonstrate the interdisciplinary nature of research. Additionally, some of the events are held off campus and targeted to families. One such event involved university researchers discussing their work on butterflies and a performance by school children of a related song that a local children's songwriter and artist wrote. The event blended science and performing arts to bring in more interest from the community.

The Vice President for Research has partnered with a local microbrewery to host a monthly event called Research on Tap where the public can meet and interact with experts from a wide range of research fields while enjoying local brews (OSU Office of the Vice President for Research 2019). These events are also recorded, and the videos are archived on the university's social media platform. The events tie in community groups to the research topics. A recent talk

related to social development of infants, children, and adolescents, and many community groups including social and human services and the local police department were in attendance to learn and discuss. Also unique about this experience is the fact that by going out into the local community to a venue not tied directly to the university and research, people are part of the experience that may never do so intentionally if it were only offered on campus. A number of other universities host similar events (Dartmouth University 2019, Oregon State University 2019).

A variety of other scientific lectures and professional development seminars on campus are open to the public. Several named lectureships across scientific and engineering disciplines and the university's Research Week events are marketed to the public to engage the community. Our engineering college hosts the Dean's Building Leadership Initiative as a monthly professional development series that is primarily focused to university staff with a wide range of roles but is open to the wider community. Several engineering faculty members and administrators have presented at the Dean's Building Leadership Initiative along with athletic coaches, community leaders, and other guest speakers.

Open online courses and lifelong learning institutes

Massively open online courses are a common trend across higher education worldwide. At our university, a local microbrewery partnered with the microbiology department to develop an online course titled Brewing Microbiology. Students can take the course for credit, but the course content is distributed to the public (Petrota 2016). The university also has an open online agriculture economics course called Farm to Fork: A Panoramic View of Agriculture (Mourer 2014). While neither of these courses was developed by engineering faculty, they relate to some of our programs in chemical engineering and biosystems and agricultural engineering.

The Osher Lifelong Learning Institutes (OLLI) are a series of programs across 123 college campuses that focus on providing non-credit courses and activities to adults that are age 50 or older (The Bernard Osher Foundation 2019). Our university has an active OLLI that runs courses in in the community where the university is located and in other cities areas around the state. Between 2005 and 2015, the program had more than 14,000 enrollees in over 600 classes across the state. While engineering is not offering any OLLI sessions this year, it would be an excellent venue for outreach to senior adults in any communities have OLLI programs. Innovative experiences beyond traditional classroom activities are also possible through this program. For example, at the University of Illinois, they have a program in which OLLI participants are paired with faculty researchers to work on lab tasks that support ongoing research (Glaze 2012).

Open houses

We host an engineering senior design expo each semester, which is open to the public. Large scale events like this and engineering open houses hosted by many universities allow members of the public to see the different types of research projects undertaken at the university in person and in a more accessible fashion than a scientific talk or journal article.

Engineering extension

Many public universities, especially those founded under the Morrill Land-Grant College Act, have extensive efforts devoted to agricultural and engineering extension services. The engineering extension program offerings vary from university to university based on their local strengths and needs of the citizens of their states. Our engineering extension activities include workforce training and professional development programs for fire service, hazardous materials, emergency response, and construction management personnel; environmental compliance training; and centers that cater to local government technology and new product development and that serve the university community and statewide and regional residents, businesses, and agencies. Other engineering extension programs targeted to adults may focus on pollution prevention, air and water quality, waste management, continuing education programs for a variety of engineering and technology professionals, technical assistance, and economic development. Additionally, outreach courses for adults have been developed on topics such as how to use technology (Luchini-Colbry and Colbry 2013).

Summary

In this paper we have described a variety of examples of university-led engineering outreach activities designed to engage adults in the public or to interact directly with senior adults. There are many opportunities for universities to grow in the number of programs that they offer that provide outreach to adults in their communities and regions with several benefits for the university and the participants described in this paper. Additionally, the experiences of designing or leading such activities help faculty, administrators, staff, and students to improve communication skills to general audiences, to engage with the beneficiaries or consumers of the products of the research and educational endeavors they conduct, and to make connections that may lead to new perspectives or opportunities.

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Biographical Information

Ashlee N. Ford Versypt, Ph.D. is an assistant professor in the School of Chemical Engineering at Oklahoma State University.

Joel J. Versypt, M.S. is a staff member in the College of Engineering, Architecture and Technology at Oklahoma State University.

Heather Gappa-Fahlenkamp, Ph.D. is a full professor and Anadarko Petroleum Chair in the School of Chemical Engineering at Oklahoma State University.