Published on *Inside Higher Ed* (https://www.insidehighered.com)

Home > Four ways higher education could make more of making and makerspaces (opinion)

Four ways higher education could make more of making and makerspaces (opinion)

Submitted by Charles M. Schweik on May 15, 2019 - 3:00am

I recently visited various higher education institutions with my daughter, a rising high school senior, as she considered applications to college. We sat through countless campus tours promoting the quality of the food, the dorms, the recreation centers and the sports teams. But in two instances, we heard them highlight a different student facility: their campus “makerspace.”

Makerspaces are physical locations with equipment that students can use to undertake do-it-yourself (DIY) projects. Arguably, they have been around for decades; we just haven’t used the name makerspace. At my institution, the University of Massachusetts, Amherst, we’ve had a student-run DIY craft shop on our campus for more than 20 years.

The difference between older forms of makerspaces like that craft shop and emerging ones is that the latter focus more heavily on digital making, such as 3-D design and printing, digital fabrication (sometimes called “FabLabs”), or the programming of open-source electronic hardware like the Arduino microcontroller. What is also new are the maker practices or principles of: 1) licensing digital designs and how-to instructions under a Creative Commons or similar copyright license and 2) openly sharing those designs through internet-enabled, cloud-based maker websites. Licenses chosen usually permit the sharing of the work with author attribution and, in some cases, permit new users to adapt and remix the work for other purposes. For example, at Thingiverse.com [1], 3-D modelers openly share their digital designs in this manner.

Maker faires -- events where makers gather together -- are becoming ubiquitous. One of the largest is World Maker Faire in New York City, which advertises itself as “the greatest show and tell on earth.” Hundreds if not thousands of demonstrations, presentations and tutorials on all aspects of the modern maker movement gather there. These are educational and enjoyable events for all ages.

Over the last four years, I’ve facilitated an experimental, interdisciplinary maker class at my university. That experience and my 20 years of scholarly work studying the collaborative principles of open-source software teams, as well hearing my university promote makerspaces and attending New York City’s maker faire several times, have all led me to identify four untapped potentials of making in higher education.

No. 1. Connecting making to mission. Colleges and universities could connect student maker activities to their educational and scientific mission in far more significant ways. A case in point: I begin my makerspace courses by introducing “makerspace principles,” and then I challenge students to identify a problem they are passionate about and want to research and help solve. In my first offering of the class, an environmental science undergrad said she was concerned about air pollution and asthma, and she proposed to research and make a low-cost, Arduino-based, open-source air pollution sensor to measure air quality around schools.

The student researched and identified equipment that I purchased for her, and she then contacted Richard E. Peltier, associate professor of environmental health sciences at the university, who had a controlled testing environment and agreed to mentor her. Another faculty member with expertise in programming Arduino microcontrollers also agreed to mentor her as she worked to program the device. By semester’s end, the student had created and documented a (CC licensed) first-generation operational open-source ozone detection sensor and data logger that was under $70.

No. 2. Longitudinal making. After that student graduated, however, the sensor still needed testing. So in the next maker class offering, I invited students to continue the project. Two students -- a master’s student in public health and an undergraduate in computer science -- took it on.

Under the continued guidance of Peltier and with access to controlled environments and professional equipment in his lab, they discovered that measuring ozone with low-cost sensors was extremely difficult. Building on the previous student's foundation, they decided to alter the device to measure particulate matter instead. They tested this new version and discovered that it performed well under laboratory conditions but became more variable under ambient conditions.

In short, the air-sensor project grew into a true scientific research project in Peltier's lab, and the longitudinal development and testing continues. More recently, a new student team is working on developing new functionality, such as a Wi-Fi data transmission capability. They are demonstrating the value of open source-based longitudinal making, whereby students take the baton from previous students and develop a project further.

I now teach this course as a one-credit class instead of a three-credit one to make it more accessible to students in majors with limited flexibility, such as engineering. That has the double benefit of allowing students to enroll over multiple semesters. Some students really embrace the project and want to keep working on it. Further, veteran students can overlap with new students and teach them about the current state of the project.

Also, by offering this class via the Digital Media Lab [2] in our university library and working with colleagues there, we've been able to give students space and support to work on their projects outside of class and regular lab time. The additional expertise that technical staff and librarians have to offer on research skills, patent exploration and open-access publishing has also provided numerous benefits. Indeed, I've found that engaging campus libraries in makerspace collaboration is extremely useful.

No. 3. Cross-organizational making. Another active longitudinal project in my makerspace class is water pollution sensing. It began through a connection I had with a faculty member at the University of Los Andes in Bogotá, Colombia, Juan Camilo Cardenas [3], who is concerned about the hundreds of illegal small-scale gold mines in Colombia and the miners' use of liquid mercury to separate gold from rock and soil. The idea was to start R&D

[4] on a low-cost water sensor that local villagers could use to test their river systems for this heavy metal. Working with associate professor Alba Graciela Avila Bernal [5] in the engineering department, Cardenas and his team developed the first open-source version of a sensor that measured temperature and dissolved oxygen, phosphorous and conductivity in water.

Several years ago, after hearing me talk about this project, some undergraduate students in my makerspace class wanted to replicate the sensor the student team in Bogotá had built. Using online meeting software, the lead engineering student in Los Andes described their sensor to my students, and our Los Andes colleagues mailed my students one of their devices for them to learn and investigate. We used the Open Science Framework [6] web collaboration system to share open-source project documentation between the two teams.

Over two one-credit semesters that followed, the team at the University of Massachusetts developed a new version of the device, swapping in an Arduino microcontroller for the original board designed by the Bogotá team. Further, while working on this new version and after some discussion with engineering faculty at UMass, my students came up with an alternative approach to the detection of mercury in water using infrared spectroscopy. To use a term referenced in open-source software development, the water pollution project "forked." The collaboration now had two different efforts going, researching and developing two alternative approaches toward detection of mercury in water.

Most recently, we've begun collaborating with a for-profit organization with a makerspace in Washington, D.C., that is developing a low-cost, open-source water sensor that would help managers of rural water supply systems in Indonesia ensure that chlorine levels in the water are high enough to kill germs. As we continue to make progress there, we will continue to update our collaborators at Los Andes and share advances.

While still unfolding, this story demonstrates the benefits of combining online collaboration tools, open-access documentation and intellectual matchmaking between students and faculty members in two separate universities and with other organizations. It underscores the potential power of cross-organizational makerspace science.

No. 4. Expanding making into nontechnology areas. These and other maker-class experiences have led me to realize that these principles can just as easily apply to the social sciences. For example, in the case of the air and water sensors, the student teams and I have started to ask, “What happens when these are deployed and pollution is detected?” That brings in public policy, management and social science questions, providing opportunities for cross-disciplinary student collaboration. Further, I’ve come to realize that the underlying principles of making (open-source licensing, web collaboration) can be applied to any problem, not just those that depend on technological solutions.

In my most recent maker class, we've begun to test this idea. In one case, a public policy graduate student proposed a new makerspace project focused on the challenges small businesses have applying for federal contracting opportunities. He spent his class time investigating and documenting the application process and developing open-source instructions on how small businesses can apply that are easier to follow. He’s now presenting his work to others, and we hope to create a longitudinal effort by engaging a new student in taking the baton from him on this project in the next maker class.

I’ve also been talking with public policy faculty at another institution about having students at each of our institutions analyze social science problems related to nearby cities. One student or student team would do quantitative analysis of a social problem in a local city and then share the approach and results with a student team at another university in another city. That team could then modify the first team’s research according to their own city’s context. The collaborative maker approach, in other words, could be applied to analysis of social problems or public policy.

Higher education institutions are only scratching the surface of the potential of makerspaces. What I have learned over four years is that joining students from different majors with faculty members with the expertise to tackle a problem, and adding maker principles, can lead to powerful educational experiences that really motivate students. Encouraging open-source documentation and online collaboration leads to both longitudinal and cross-organizational collaborative opportunities that are unusual in current-day higher education.

Colleges and universities should consider academic programs that, by design, consider the potentialities I've described above. These are untapped opportunities that can provide students with a far richer academic experience.

Charles M. Schweik is a professor of environmental conservation and public policy at the University of Massachusetts at Amherst.

Section:
Teaching and Learning [7]
Editorial Tags:
Teaching [8]
Image Source:
Istockphoto.com/Geber86
Is this diversity newsletter?:
Disable left side advertisement?:
Is this Career Advice newsletter?:
Trending:

Source URL: https://www.insidehighered.com/views/2019/05/15/four-ways-higher-education-could-make-more-making-and-makerspaces-opinion

Links

[1] http://thingiverse.com/
[2] https://www.library.umass.edu/dml/
[3] http://economia.uniandes.edu.co/cardenas
[4] https://vimeo.com/272734334
[5] https://academia.uniandes.edu.co/AcademyCv/a-avila
[6] http://osf.io/
[7] https://www.insidehighered.com/news/focus/teaching-and-learning
[8] https://www.insidehighered.com/editorial-tags/teaching