MAKERSPACE

Colleges and universities nationwide are capitalizing on the role that makerspace plays in education, research, entrepreneurship, economic development, and STEM by investing and allocating space for today's "makers." With an increased emphasis in higher education on curriculum-to-careers and the drive for graduates to obtain good jobs in growing fields, makerspace provides opportunities for academic institutions to partner with industry to invent new products, promote student entrepreneurship, create a pathway for students to connect to internships and careers, and spur regional economic growth.

What is a Makerspace?

Makerspace is a physical laboratory for self-directed, inquiry-based learning, problem-solving, and design thinking. The students or "makers" gather in an intentionally-social environment to make just about whatever they can imagine with access to an enormous variety of materials and tools. In this era of virtual reality, a key feature of makerspace is that it revolves around *real* -- rather than *virtual* -- tangible, hands-on, experimentation and creation of "things" that often include technological or electronic innovations.

The fundamental premises of makerspace:

- a learner-driven environment where makers have complete freedom to experiment and innovate in well-equipped workshop-style spaces; and
- a strong community environment that encourages makers to work individually or in collaboration with others, sharing resources and knowledge, developing ideas, cooperating on projects, and networking.

This community-building aspect of makerspace have led some to describe it as "a social movement with an artisan spirit." Today's Makerspace incorporates artists, technology enthusiasts, engineers, builders, crafters, and Do-It-Yourself (DIY) tinkerers – all interested in using the elements of makerspace to create and make physical "things."

Application in Academia

Academia is quickly recognizing the value of makerspace as a learning opportunity. First emerging on the campus of MIT in 2001 and gaining presidential support at the first White House Maker Faire in 2014, makerspace has been created at an estimated 400 colleges and universities nationwide – and that number continues to grow.

At Case Western Reserve University in Cleveland, Ohio, their makerspace dedicates incubation space for student projects and entrepreneurial development offices for patenting, legal advice, and finding investors. Others, like Harvard University's I-Lab in Boston and North Carolina State University's Product Innovation Lab, have advanced the more traditional makerspaces into purely entrepreneurial laboratories that focus on teaching students how to create new products and get them to market.

Makerspace is in many ways a natural fit with academia, cultivating the development of an innovative community of thinkers and makers that unite classroom and experiential learning to bridge the gap between theory and practice. The lure of makerspace to today's campuses is its consistency with the movement in academia towards more learner-centered instruction. Makerspaces are safe learning

environments where failure is considered a positive sign of creativity and students can experience a powerful sense of agency through experiential learning and collaborative problem-solving.

Making fosters creative, higher-order problem-solving through project-driven, hands-on design, physical construction, and iterative learning. The highly collaborative and dynamic environment of a makerspace promotes multi-disciplinary thinking and learning. Informal, unscheduled activity allows for self-directed learning that demands that student makers take control of their own education. Increasingly, student maker portfolios are being accepted, allowed, and even required in the admissions process at mainstream academic institutions.

Getting Started

Creating a makerspace on a college or university campus is within reach of any institution with available or underutilized space, a pilot budget, and sponsors driven to making it happen. There are no definitive sets of standards or best practices to guide those seeking to create a makerspace – the onus is up to each maker community to determine what it wants to make and do, and decide on the tools, resources, and raw materials needed to equip the space. However, there are four components of all successful makerspaces that institutions should take into consideration:

1. A **Founders Group,** typically made up of dedicated faculty, researchers, administrators, and/or students with a vision for the institution's makerspace, is desirable to oversee the many tasks needed to usher it into existence. For academic makerspace, it is important to get faculty buy-in to the concept, and link the pilot space to the curriculum to build the use of the space into projects assigned to students. Some institutions are finding collaborative partners in local businesses or industry to create public-private hybrids that enhance town-gown relations, provide students with internships and links to future jobs, and turn student projects into entrepreneurial businesses.

2. The proposed **Space** should be large enough, dedicated, and appropriately "messy" so as to encourage makers to freely work both on their individual projects and to collaborate on group projects. The space should also provide a secure home for the equipment and consumable materials critical for making. Adequate permanent space allows makers to safely leave their projects in progress over time so they can return for the next stage of modeling. Makerspaces typically start up with whatever ad hoc space is available, but often outgrow their initial space allotment.

   The overall size of academic makerspaces can range from a 200 square foot space – much like the Makerspace in the Sawyer Library at Williams College – up to a more expansive space as in Case Western Reserve's 50,000 square foot multi-story space in a former industrial building at the edge of campus. Regardless of how the space is initially conceived, most makerspaces grow over time either within the same building or expand to another location.

3. Makerspace is all about the **Stuff** -- the technology, supplies, tools, consumable materials, equipment, power, and connectivity – all of which is needed to facilitate modeling, fabrication, iteration, and experimentation. The fundamentals are electrical power, computer servers, networking, and internet. Beyond that, each maker community determines its own unique collection of machinery, tools, and raw materials based on what it wants to make. Certain equipment, however, tends to be nearly universal in makerspaces and may include – but is certainly

not limited to -- large format rapid prototyping 3-D printers, LEGOs, Raspberry Pi computers, Arduinos, welding equipment, milling machines, laser cutters, woodshop tools, sewing and cutting machines, computers, CAD/CAM/Design software, Computer Numerical Control (CNC), plasma cutters, soldering facilities, metal shop tools and equipment, along with raw materials like plastic, cardboard, wood, batteries, paint, and fabric.

4. **Open Access** to the space is key to inviting use, encouraging creativity, and fostering community. Additional aspects to consider include paying staff salaries, providing security, managing safety and liability issues, and making sure that everything runs smoothly. While volunteers often assist with managing makerspaces, the liabilities associated with operating an institutional facility equipped with potentially dangerous machinery requires knowledgeable, professional staff to ensure safety and security, and provide necessary instruction. The option also exists to segregate the more specialized equipment from the basic tools and supplies, which may help control access.

   In terms of scheduled access, 24/7 is ideal, especially for students, but obviously increases associated costs. A highly visible and central location on or within easy reach of campus is recommended, as is visual transparency in the design of the space. Clearly communicated operational policies about when the space is open, who can use it and for how long, who supervises it, what the safety regulations are, where projects can be stored, etc. provides a basic working structure as part of open access.

Conclusion

With a founder's group, a space, a budget for initial fit-out, and staff to provide supervision and training, an academic institution can begin seriously considering a makerspace and what will best serve its unique community of makers. Most successful makerspaces at colleges and universities appear to be driven "from the ground up" rather than from "the top down." In other words, the interest and passion of the founders drive the need for space and generate interest among other makers, rather than the other way around. The lesson for institutions is to foster the natural maker spirit and be prepared to support it when it presents itself.

Finally, makerspace has been shown to add value to college and university programs by attracting and retaining top talent students, empowering them to learn by doing and making. Today's institutions are enabling students to connect to the larger world with skills and tools needed to succeed in internships, jobs, and future careers through the investment in makerspace.

Contributing author: Susanne Personette

Originally published in 2016