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HIGHER EDUCATION MAKERSPACES

Engaged Students, Hands-on Skills, Interdisciplinary Connections

by Mark J. Maves and Vincent Wilczynski



The academic makerspace has emerged as a nascent and intriguing tool as higher education explores ways to enhance learning and innovation. It appears to hone critical thinking, develop teaming skills, advance capabilities in the application of knowledge, and foster self-directed learning. Makerspaces forge new collaborations and interdisciplinary interactions across the campus, enrich the discussion about what “hybrid” learning is, and contribute to the cultivation of a workforce that can work nimbly in an innovation economy.

“The development of an academic makerspace needs to start with the fundamental concept of community and collaboration,” says co-author Vincent Wilczynski, deputy dean, Yale School of Engineering & Applied Science. Its mission must be clearly defined from the onset, and its space designed around that mission. “Then, based upon those principles, you work on the rest of the concepts, such as what will the space be used for? Who will I partner with?”

“Universities have always provided elements of makerspaces, including machine shops, assembly and testing areas, CAD labs, meeting spaces, and classrooms,” adds Wilczynski. What universities have not always done is include all of these elements in one location and make the resulting space widely accessible to an academically diverse campus population.”

Best Practices and Planning for Adaptability

Planning for adaptability is key in the design of a makerspace. Most equipment, other than the largest pieces, is on wheels; few

things are permanent within the space itself to ensure adaptability and flexibility. The more useful spaces are generously proportioned, technologically rich, and provide a range of settings in which to interact. Key to the long-term sustainability of a makerspace is adopting the view that furnishings and programs are not permanent, but instead adapt to the changing needs of users.

The intentionally open design of a makerspace fosters a sense of community so people aren’t working in silos and closed rooms. “The connections that come from people’s awareness of each other’s projects stimulate dialogue and diverse perspectives,” says Mike Moss, president, Society for College and University Planning. The lack of physical barriers increases the likelihood that teams of students with diverse academic and experiential backgrounds will be formed.

Variety of Approaches

Yale University Center for Engineering Innovation and Design (CEID) serves as the hub for collaborative and interdisciplinary design activity for the entire campus. The CEID is an 8,700-square-foot, two-floor space in a larger building. The open design includes a large studio, an open lecture hall, meeting and team rooms, and specialized areas such as a woodshop, machine shop, and biological wet lab. The CEID studio features rapid prototyping equipment, a cutting and sewing area, hand and power tools, electronic workstations, five 3-D printers, and more. It’s open to all individuals at Yale and hosts courses and guest lectures, social activities, hackathons, and student clubs.

The range of activities demonstrates the involvement of the entire university in the CEID. A recent course paired the music department with design faculty, representing a musician, a composer, a programmer, and a physicist. The class explored acoustical theories of various musical instruments and explored musical properties by designing unique and original instruments.

Jacobs Institute for Design Innovation at the University of California, Berkeley, is another interdisciplinary hub for learning and making, simultaneously providing an academic building and a community space. Its 24,000-square-foot space on four floors includes three studios, an all-purpose makerspace, and several specialized labs such as a woodshop, metal fabrication lab, AV production lab, and CAD/CAM computer lab. It is part of a larger network of centers on campus that Berkeley, not surprisingly, refers to as its innovation “ecosystem.” The Institute extends its resources to the entire campus, seeking and stimulating new relationships and collaboration within the academic community.

Each semester, hundreds of undergraduates present their work in fields including design, tech, engineering, and the arts in the Jacobs Design Showcase. Bioinspired Design is one of the wide-ranging courses that takes place at Jacobs Hall. A sample project from this course, PUM, modeled relief package devices for food and medical supplies after mono-wing maple seeds for more accurate airdrop delivery to isolated or inaccessible emergency areas.



PHOTO: TIM GRIFFITH

Liberal arts and community colleges. Many smaller colleges, especially liberal arts institutions, are exploring and building makerspaces. Williams College's is in the library, a frequent location for those looking for a common geographic ground. Davidson College's Studio M is premised on three terms: open, engaged, and experimental. Initial projects in Studio M involve the Department of Mathematics and the Department of Visual & Performing Arts.

Vassar, Colorado, and Lafayette Colleges are exploring makerspaces in an effort to build on the Yale and University of California Berkeley examples of engagement with literature, music, history, and fine art. While Colorado College develops its approach and location, it is providing interim memberships in a nearby community-based makerspace.

Community colleges are also creating makerspaces on or off their campuses to foster problem-solving, build greater access to new technologies, and stimulate interest in careers that address regional workforce needs. "For us, when we think about jobs and the economy, we know that we need to have a strong STEM/STEAM strategy in order to produce a strong workforce," said Van Ton-Quinlivan, vice chancellor for Workforce and Economic Development for the California Community Colleges. "We're increasing investments in strategies that can build those types of skill sets. So connecting community colleges into the



PHOTO: YALE CENTER FOR ENGINEERING INNOVATION AND DESIGN

Maker Movement is part of our InnovationMaker portfolio." Of the 113 institutions in the California Community Colleges, 15 have makerspaces and another 23 are pursuing makerspaces for their campuses.

Emerging Trends

Co-chairs from the 1st International Symposium on Academic Makerspaces (November 2016) and members of the Society for College and University Planning have observed these emerging trends:

- **Assessment:** Future development of makerspaces should strive to include assessment as a component of the teaching and learning experience. This also meets the expectation of accreditors and helps validate the purpose of makerspaces for college administrators.
- **Wide Spectrum for What Is Considered a “Makerspace”:** Makerspaces range from a single crafts-type room with 3-D printing to a full fabrication shop with heavy machinery. The definition/composition varies from institution to institution.
- **Concept of Entrepreneurship Within Makerspaces:** A number of makerspaces are augmenting their programs with entrepreneurial activities. Also, schools with entrepreneurship programs are creating makerspaces as start-up environments for their students who want to create prototypes of the products they are working to commercialize.
- **Value of Makerspaces Within the Engineering Education Curriculum:** There is an accreditation-driven move to increase design content in the undergraduate engineering curriculum. The value of makerspaces to augment this design experience is becoming more established and is gaining the acceptance of engineering accreditors.
- **Makerspaces Expand Into Libraries, Student Unions, and Residential Life Communities:** Student unions, libraries, and residence halls seek ways to transcend the traditional social mission to include serving as hubs for innovation, entrepreneurship, engagement, and creativity.

“These experiences beyond formal learning are becoming a valuable part of the college and university experience,” said Moss. “Makes us all wish we were freshmen again.” **LBD**

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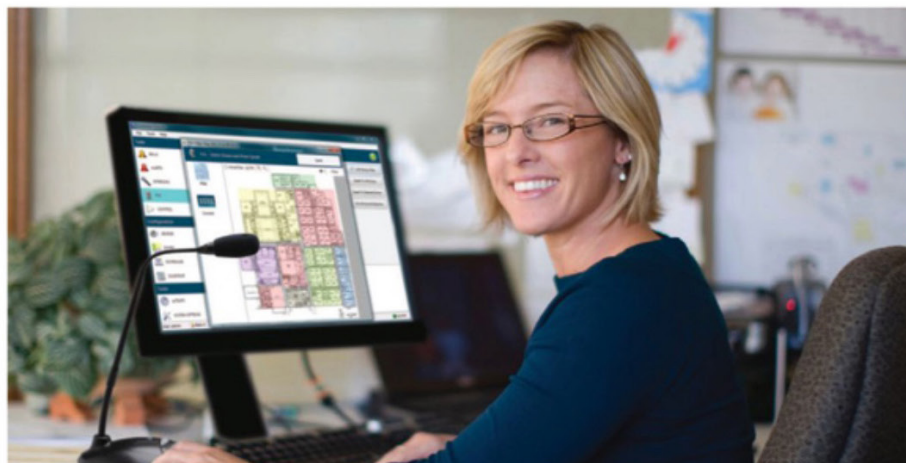
Resources

International Symposium for Academic Makerspaces (ISAM): <https://project-manus.mit.edu/home/conference>

Society for College and University Planning (SCUP): <https://www.scup.org>

Higher Education Makerspaces Initiative (HEMI): <https://hemi.mit.edu>

Learning Spaces Collaboratory (LSC): <http://www.pkallasc.org>



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