



# Maker Commons in the Modern Library

## 6 REASONS 3D PRINTERS SHOULD BE IN YOUR LIBRARY

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The best college and university libraries are hotbeds of innovation. To push the cutting edge of education and the quest for knowledge, librarians have embraced new forms of technology, creative learning spaces and anything else they can come up with to benefit their patrons.

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As University of Nevada, Reno Engineering Librarian Tara Radniecki asserts, the new breed of librarian is “less of an instructor or information guide—more of a coach, mentor, co-conspirator.”

Many librarians have come to recognize the impact of having makerspaces within library walls. It’s a major draw for faculty and students to explore new kinds of collaboration, coursework and research. It’s also a means to entrepreneurialism. At the heart of these spaces resides the 3D printer—constantly transforming virtual ideas into physical objects.

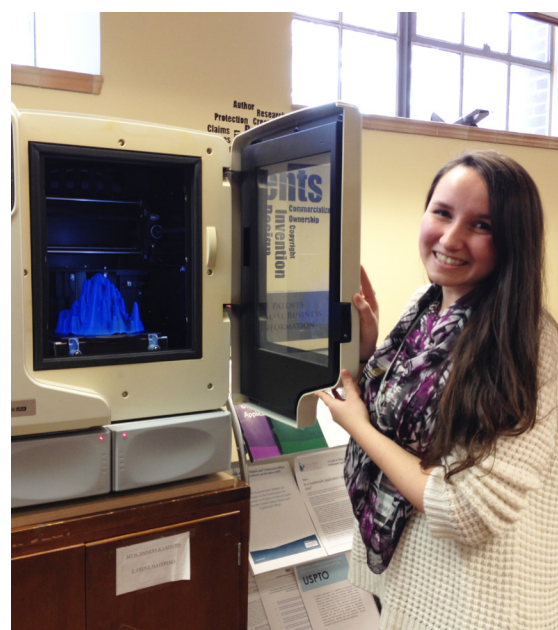
What is it about the library environment that makes it so conducive to the makerspace movement? This report will explore the many reasons 3D printing belongs in your library, based on the experiences of two institutions. The University of Nevada, Reno has three libraries, including the DeLaMare Science & Engineering Library. At the other end of the spectrum, Pennsylvania State University encompasses 15 libraries at its main campus in University Park and 23 additional libraries at campuses spread across the state.

### 1. Librarians Know How to Share

The coolest technology is often acquired by a single department or faculty member for a specific

research project. “After they’re done using them, they kind of die in people’s offices,” says Radniecki. After all, those faculty members have no obligation to do anything else with them.

Librarians, on the other hand, are expert at providing resources and services for everybody to use. “We’ve already established workflows,” she says. In the case of 3D printing, “We have to keep track of that job from the computer to the 3D printer, from the 3D printer to the soak tank, the soak tank to a staff employee who will contact the patron while we store it.”



Sierra Gonzales showing off a uPrint 3D printer at University of Nevada, Reno.



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It's not without its struggles, but librarians are often prepared. "It's so easy when you're doing a large quantity of 3D printing for things to get lost, so there's also the workflow of inventory," she says. "That has all been a learning curve for us."

Librarians also know how to show off what they have in the library. Combine that with the traffic a typical university library sees and putting 3D printing front and center makes perfect sense. It can draw the right kind of attention from potential students and donors, says Sig Behrens, general manager for education at 3D printing solutions company Stratasys (and a Penn State alumnus).

These technologies "help attract students that want to come and be creative and do great things," he says. They can also pique the interest of benefactors and alumni who get excited about new approaches to learning and want to participate in supporting that.

### 2. Librarians Work Well with IT People

Penn State University Libraries already operates the Knowledge Commons for individual and group study and the Media Commons for multimedia support. Its most recent addition is Maker Commons, a new space to support students

and faculty who want to do 3D printing, rapid prototyping and design thinking. The lynchpin of the Maker Commons is a collection of 36 3D printers that provide on-demand, open access 3D printing to any member of the university community.

Setting up the Maker Commons has been a joint effort of two campus organizations: the library itself, which secured funding, and Education Technology Services (ETS), a division within the larger Teaching & Learning with Technology, which designed and implemented the 3D printing service and supports it.

"The idea is that we have very similar service ethics and outreach needs," says Joe Salem, associate dean for learning, undergraduate services and commonwealth campus libraries. "Libraries work a lot with faculty on research and their instruction and coursework, their pedagogical innovations. And so does [ETS]. It's a really nice mutual kind of mission goal for both of us."

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### 3. Librarians Serve Everybody

Anybody can come into University of Nevada, Reno's science and engineering library with an STL file (the format readable by a 3D printer) on a USB drive and request a print job. Patrons don't need to go through any special training. They don't even need to be part of the campus community. Anybody can come in and request a print job. "There's no such thing as 'permission,'" says Chrissy Klenke, Earth Sciences & Map Librarian.

printer software, and a student knows right away if it's too expensive," says Radniecki. "Maybe they need to adjust the file or make it smaller or hollow it out or something like that."

Once the file is optimized for 3D printing, Stratasys proprietary software called CatalystEX™, slices and orients the model and creates the necessary support structures for the ultimate printing process. CatalystEX also maintains the queue as print projects line up.



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— Chrissy Klenke, Earth Sciences & Map Librarian.

Student workers—or "tech wranglers" in library parlance—run the STL file through Netfabb, a utility that evaluates it for design problems and printing efficiency. The program calculates how much material the file will need for printing and suggest ways to optimize the design. The university uses a fee system based on the amount of materials expected to be used for the printing. "We know how much it costs as soon as we put it into the 3D

### 4. Librarians Can Fill Learning Gaps

There are subjects students need to learn that are best served by faculty in the library staff. Digital literacy was in that category for a long time. Now it's evolved into "information literacy," says Salem. That encompasses, "finding, using, evaluating, creating and ethically using information."

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The rack of 3D printers in the Penn State 3D printing lab.

Libraries are well positioned to take responsibility for that kind of instruction. “Since we have such a robust outreach and instructional program, things like 3D printing and a lot of the related issues and opportunities around that are increasingly part of what that outreach looks like,” he says. “We anticipate that that will only continue to be the case.”

“Maker fluency” is the term Kyle Bowen uses to describe what’s needed by students to ensure they’re ready to undertake coursework involving 3D printing. “This meta experience combines 21st century skills like collaboration and solution development and creativity and brings us together into singular activities,” says Bowen, the director of teaching and learning with technology in ETS.

“3D printing makes it possible for us to create these fluencies for our students so they can learn about collaboration, learn about what it means to develop new solutions, learn about what it means to be creative and apply that to the creation of a product or the creation of an idea in such a way that it doesn’t just fulfill the need of that assignment, but rather helps them as they engage new or different technologies in the future.”

One example Bowen points to is a recent project undertaken by 300 engineering students. Those students were given a design challenge dealing with buoyancy. They had to design and print a boat that could hold the greatest number of pennies. The Maker Commons printed about 100 different iterations of boats. “These students were able to apply that thinking to something they could physically engineer. It was a design challenge for which they could get immediate feedback. They were able to essentially develop those skills they could apply to design problems in the future.”

### 5. Librarians like Student Workers

Librarians are used to putting students in charge of helping people for certain kinds of activities. That philosophy meshes well with the 3D printing process.

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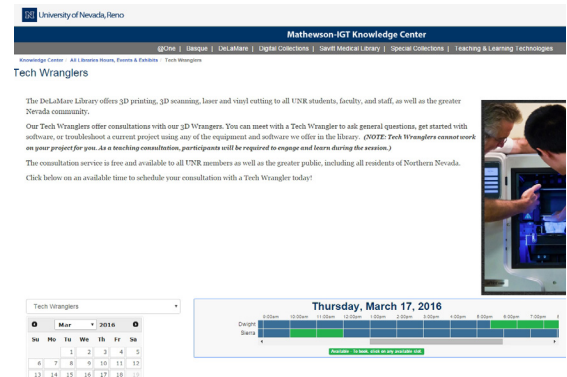
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University of Nevada, Reno hires mechanical engineering students to work as tech wranglers. They serve as 3D printer consultants and help with other equipment in the library's makerspace. When somebody brings in an STL file, they're the ones who run it through its paces, perform basic troubleshooting and even help the patron "fix small sorts of things," says Klenke. They also have experience with the most commonly used design programs at the university, TinkerCad, SolidWorks, OnShape and Blender.

The tech wranglers are also the people who "keep abreast of all the new software that's coming out," she adds. "They're the ones who discovered OnShape as a new, freely available program that far surpasses Blender in usability. We rely heavily on them and their expertise."

During the 2014-2015 academic year, those student workers consulted 243 times and helped print 2,263 3D pieces. Eight out of 10 of those were new creations designed by patrons, not files downloaded from an STL sharing site.

To prevent patrons from having to stand around waiting for help in the makerspace, the school uses a Web-based scheduling utility that shows tech



Student 3D printing assistants are called "tech wranglers" at University of Nevada, Reno.

wrangler availability on a daily basis. It also lets people schedule a consulting appointment. Penn State is just beginning to follow a similar course. Currently, the libraries rely on multimedia specialists to help patrons "get access to the technology or think through how they might accomplish projects," says Bowen.

Now the institution has introduced "makers in residence," students with expertise in 3D printing and prototyping. Going that route, says Bowen, will provide "peer-to-peer interaction" and help the university develop a model to help scale its services to all campus libraries the institution operates around the state.

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### 6. Librarians are Cross-Discipline

Introducing the makerspace at University of Nevada, Reno's DeLaMare library has actually brought many of the engineering and science faculty "back to the library" and get reacquainted with its services, says Radniecki. The makerspace has also drawn many other faculty—including people from art, psychology, anthropology, computer science and health sciences.

"It's an easy kind of pitch to say, 'Oh, it's an engineering library or a sciences library, so therefore, there's all sorts of practical reasons why there should be 3D printers,'" says Klenke. "From what we've seen, there are a number of different departments across many different disciplines that utilize the 3D printers."

As a result, many departments have greater reason to help the library fund its new technology initiatives, so it doesn't all come out of the library's budget. As Radniecki says in a presentation on library innovation, 31 faculty members across the

campus supported the library's makerspace at University of Nevada, Reno.

The psychology department funded handheld 3D scanners. The engineering department and the vice president of innovation and research funded an additional 3D printer and laser cutter to be housed at the library. The latter also covered the cost of adding a PCB milling machine to the makerspace inventory.

Cross-disciplinary missions don't just refer to reaching across multiple subjects. It can also mean reaching out across multiple goals. Penn State's Maker Commons is focused on three areas. The first is coursework. "We want to make sure students have access to the 3D printers in whatever form they need so our faculty can be as creative as they want to be in terms of creating assignments and assessments that involve 3D printing," says Bowen. "We know with confidence that students will have access to that technology and the support they need in order to use it."



"3D printing makes it possible for us to create these fluencies for our students."

—Kyle Bowen, director of teaching and learning, ETS, Penn State



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As the popularity of the service expands, the Maker Commons will also focus on entrepreneurship and research. “As students have new ideas they want to prototype or they want to explore or around companies they want to start or around activities they want to support or causes they want to enable, they would have a facility that would help them do that,” says Bowen.

Likewise, he says, “As our students engage in research projects in and around additive manufacturing, material science, any number of areas that can involve 3D printing, they have the facilities that can help them do that, especially in undergraduate research.”

### The Future of 3D Printing in Libraries

When computer labs first surfaced in the 1990s, they provided computer access to students who didn’t have their own machines or the software they needed for their coursework. 3D printers are following a similar adoption path as the idea of “maker commons” percolates in the institutional realm.

“Back then, people could not afford their own computers and couldn’t troubleshoot them or figure things out. You needed a different method. Computer labs originally designed for computer science opened up and become more accessible to every student, regardless of discipline,” says Stratasys’ Behrens.

The same thing is now happening with 3D printing, he says. “Because of that demand, because of that interest in accessibility, these larger learning commons are starting to take off.” He counts a dozen makerspaces, each with multiple 3D printers in school libraries right now, including the University of Maryland and Florida Polytechnical University. Penn State has one of the larger sites. “And they’ve got ambitious plans to go even bigger.”

Just as computer labs eventually adopted management software to let IT monitor and manage the computers from a single console, the same is being introduced for the printers in the maker commons. Penn State users can now submit their print jobs online. Bowen’s staff can manage those printing jobs remotely, “so we can begin to see how students are submitting them, what the popular types of filament are, how the prints are coming in, how they relate to coursework and so on.”

The “cloud-based” service that’s being embedded into the “physical activity” of performing a 3D print offers amazing potential for the maker commons, Bowen says. “This management layer makes it possible for us to extend these services to our campuses across Pennsylvania.”



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The university can also extend those services to distance students taking courses from anywhere in the world. “They have access to the same 3D printing technology,” he says.

That’s where another longstanding library process comes into play—the inter-library loan. Libraries already share resources with one another using “existing courier systems,” notes Salem. Using the management service would let a user send in a print job, monitor its status and have it delivered. “It’s just like you would any other material delivered from the library — without really creating a whole other infrastructure.”

Penn State is now “envisioning a model where libraries with a much smaller footprint for 3D printing” could offer large-scale support by supplementing their offerings with the 3D printers at other campuses. And a shared program could go “multi-institutional,” says Salem.

So why put 3D printing in your library? University of Nevada, Reno Junior Sierra Gonzales is a mechanical engineering student who has worked as a tech wrangler in the engineering and science library for about a year and a half. She knows why it’s the best place for this technology. “People recognize libraries as spaces where you can come and get help. A lot of people come in here and say, ‘I don’t know how to fix this problem.’ And we suggest things that they didn’t even know were possible. That’s the number one reason. We’re here to fix problems and help them get to where they’re supposed to be.”



“These larger learning commons are starting to take off.”

—Sig Behrens, general manager for education, Stratasys

## Lessons Learned

Here are a few lessons learned from institutions that have already deployed 3D printers:

**Query your faculty:** Before you add 3D printing to your library, find out what instructors need and want. Penn State Libraries convened groups of faculty already working in maker areas to understand what their interests were going forward, as well as their current challenges. As University of Nevada, Reno's Radniecki says, "It's about talking to your community and seeing what they need."

**Help faculty embed 3D printing into their curriculum:** Penn State held a fall event called "Make It," where the librarians and ETS brought faculty together. They engaged them in the types of coursework for which they could use 3D printing, says Bowen.

"They got to learn firsthand what some of the possibilities are," he says. "Things that faculty learned at that event have already been implemented in the Innovation Center in the library. We're already starting to see that kind of faculty engagement pay dividends, even as early as we are in this process." To learn more about 3D printing, check out <http://www.stratasys.com/industries/education/resources>.

**Don't choose 3D printers based solely on price:** If you're simply letting people tinker, then go lower end, says Radniecki. "But if you're talking about an academic library where you want to offer it as a service, it's absolutely worth investing. I can't imagine how many hours of staff time and money we've saved

by going with a higher-end machine." Examples of higher end 3D printers include the Stratasys Idea, Design and Production series 3D printers.

**Seek tech self-sufficiency but get the maintenance package:** The University of Nevada, Reno, librarians and tech wranglers handle the 3D printer maintenance. Every 500 hours of operation, for example, they run a 25-minute process to change print heads and recalibrate the printers.

In spite of that self-sufficiency, Radniecki advises any library purchasing 3D printers to procure the maintenance package. Although she and her fellow librarians can handle the basics, if something goes further wrong, they like to be able to contact the company for support.

**Think expansively about how to apply 3D technology:** The Penn State Libraries have special collections with 3D objects, such as small sculptures. "They're rare and we want to show them off, but they've never been part of the curriculum because you don't want them handled," says Salem. "Now we have a great opportunity to 3D scan them and recreate them."

From there, they can be put into the hands of students on campus, online for online students and even out into schools for K-12 outreach. "So get as creative as you want, to help your students think creatively about what the technology can provide and how it fits into your outreach and instruction."



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