Jennie Levine Knies, Valerie Lynn, and Erik Angel

Parallel lives

Two Penn State campuses launch 3-D printing

Penn State-Hazleton and Penn State-Wilkes-Barre are two of Penn State's 24 campuses, both located in Northeastern Pennsylvania, offering similar baccalaureate four-year degree programs. There are also several associate degree programs; however, many students take advantage of Penn State's "2+2 Degree Plan," in which students spend the first two years of study at one Penn State campus and then transition to the main campus at University Park or another campus for the remaining two years. Because of the mobile student body, students and faculty often have difficulty engaging academically with others outside the classroom. The addition of 3-D printing at both campus libraries has proved to be an excellent way to increase campus connections.

3-D printing is still a relatively new technology that is being used by a variety of disciplines. Many think of it as relevant to engineering and the sciences, but it is interdisciplinary and has uses that range from the humanities to health sciences to business.[1]

Getting started

The Hazleton and Wilkes-Barre campuses experienced parallel evolution of their 3-D printing programs. At the Hazleton campus, two faculty members from the Physics and Engineering units approached the library staff in 2014 to inquire whether the library would be willing to house a 3-D printer to support their academic programs. The librarians saw this as a good opportunity to part-

ner with faculty in providing access to newer technology. The professors wrote a grant to purchase a LulzBot TAZ 5 3-D printer, a preassembled printer with the ability to self-replicate replacement. This reliable printer is meant for the average/advanced user who is looking to expand their knowledge of 3-D printers. With a large build volume, the ability of mass printing requiring little to no calibration enables the user to produce in volume. The university libraries approved additional funding to the operating budget to purchase supplies on an ongoing basis.

At the Wilkes-Barre campus, engineering students could access several 3-D printers in the technology center laboratories. In this case, the librarian approached a faculty member in engineering with the idea of placing a printer in the library. In 2015, the library started a pilot program with a low-budget Micro3D printer, a small entry-level desktop printer. With its small footprint, basic setup, and low cost, it enables users to experiment with 3-D printing without a substantial investment of time and money. Following the success of that pilot, the library purchased a Tinkerine DittoPro the following

Jennie Levine Knies is associate librarian/head librarian at Pennsylvania State University-Wilkes-Barre, email: jak6029@psu.edu, Valerie Lynn is associate librarian/head librarian at Pennsylvania State University-Hazleton, email: vag3@psu.edu, and Erik Angel is information resources and services support specialist at Pennsylvania State University-Hazleton, email: ema33@psu.edu

semester. The Tinkerine is similar to the M3D in that it is an entry-level desktop unit, but it has a build area almost double the size, which allows users to expand designs with more complex elements. The faculty member also loaned the library a Rostock MAX v2 3-D printer, which permanently resides in a prominent position in the head librarian's office. The Rostock MAX v2 printers are sold as either do-it-yourself (DIY) kits or fully assembled. This printer is meant for the average 3-D printing user. It requires more initial setup and maintenance, especially in keeping the printer calibrated during continued use. Users can add self-printed parts, both as replacements and for expansion of features. At Wilkes-Barre, the Engineering faculty member and the librarian also obtained grant funding to purchase three 3-D printer DIY kits (Prusa 8-inch i3) to be assembled by Engineering students and then used in the library. Once again, the university libraries approved additional funding to the operating budget to purchase supplies on an ongoing basis.

In both these cases, the introduction of 3-D printing technology to the library predated the formal MakerCommons (makerspace) at the main campus in University Park, which opened during the spring semester of 2016. In fact, Hazleton and Wilkes-Barre remain the only two libraries in the Penn State system to offer 3-D printing programs (Penn State Schuylkill has a 3-D scanner). The makerspace on the main campus will accept prints from any campus in the system, however there are problems with a centralized service. 3-D printing requires tweaks and personalized communication between the patron and the printer operator to create prints that are truly satisfying. In the beginning, the makerspace services were inundated with requests, forcing them to halt new requests towards the end of the spring semester. Implementing 3-D printing at campus locations was less complicated due to the following factors:

- smaller student body size,
- anticipated use of the 3-D printers,
- low-overhead costs,
- flexible space requirements, and

- support and explicit encouragement for innovative programs from the central library administration.

The Hazleton and Wilkes-Barre libraries offer 3-D printing services for free, and there are no formal limits on number of prints, only limits on size. Both campuses restrict access to only the campus community. Each location designated an employee as a 3-D printing specialist, to act as the local expert for the 3-D printing equipment. An enthusiastic point person allows for personalized support and is a good customer service model. Both created basic policies, based on those at other academic libraries. Some designs are restricted; neither campus will print weapons or weapon-like items, and both have a "reserve the right to refuse" clause. At Wilkes-Barre, only trained staff initiates a print. Hazleton trains students to become approved users who then initiate prints on their own.

Student engagement was a key motivating factor; especially exposing students in the humanities and social sciences who otherwise might not have opportunities to interact with this technology.

Marketing

Both campuses used a variety of techniques to market the 3-D printing programs. The 3-D printer itself is an excellent outreach tool—Wilkes-Barre's 3-D printer is visible immediately upon entering the library, and Hazleton's is located in a collaborative area in a room with a big window. Library staff observes that the 3-D printer entrances people who visit the library. It is an excellent conversation-starter. Often students with some experience will start explaining the technology to other students who ask questions. Wilkes-Barre's 3-D printer prints objects that are needed in the library, for example, doorstops, book cradles, pen holders, bag holders, and furniture coasters. They have printed props for faculty to use in classes and other activities, such as lizards to demonstrate techniques for catching lizards in the wild and a geoid 3-D model (a circular, topographical model of the earth). Hazleton's prints include 3-D mathematical

representations, items for exhibits, and testing tinsel strength of objects.

Hazleton and Wilkes-Barre used traditional methods to market their 3-D printing programs. Both advertised the 3-D printers on their websites, and were mentioned on the Penn State University Libraries' official Libguide for 3-D printing. Wilkes-Barre and Hazleton routinely post photographs of 3-D-printed objects on its social media sites. Wilkes-Barre used Canva,[2] an online graphic tool for developing promotional materials, to design flyers and signs to post around campus and the library. Hazleton's 3-D printer was featured in an article in the Penn State University's online newsletter, and Wilkes-Barre's 3-D printing program was recently featured on the campus's website. Both campuses mention the 3-D printing during relevant instruction sessions, and also encourage faculty to think about how they might incorporate 3-D printing into their curriculum.

3-D printed Tyrannosaurus Rex skull.

Lastly, students who successfully use the 3-D printer serve as the best ambassadors for the programs. They show off their prints to their friends and inspire them to visit the library to make their own prints.

How students use the 3-D printers

One of the first questions students ask when considering 3-D printing is where to find designs. Websites such as Thingiverse[3] are open-access design repositories. Students can search for any topic or idea, and usually find what they need. If the student is unable to find an existing 3-D model, or if the student wants to edit or amend an existing model, several free software tools exist for entry-level users. The most accessible is the web-based Tinkercad,[4] which allows users to import existing designs and modify, or to create new designs, using software-supplied shapes, letters, and resizing tools. AutoDesk Meshmixer[5] is downloadable software that contains more advanced features than Tinkercad, such as 3-D modeling and sculpting, and the ability to add in supports. It also provides advanced predetermined shapes—one staff member created a version of Penn State's Nittany Lion with a rabbit head in a matter of minutes. More advanced users turn to software such as SolidWorks[6] and AutoDesk AutoCad.[7] Both programs use a design process known as parametric modeling, which allows users to create highly detailed drawings in 2-D/3-D model space with extremely tight tolerances for projects, such as machine parts, jewelry, household items, and many more. The difference between these programs and more commonly available programs comes from the ability of users to have a large amount of tools available that allow more control of the design process. In order to better assist students, it was essential for library staff to experiment with these tools.

Students found the technology intriguing and exciting. While the first prints were Penn State-themed (lions and keychains), students began to think more creatively about their prints. One popular inspiration for student prints is cosplay (costumed roleplaying). Students have requested a variety of magic wands, badges, emblems, and other trinkets to use as accessories for their costumes. Items for display or exhibition, such as historical representations of military vessels (a Viking ship and a World War II naval battleship), the skull of a Tyrannosaurus Rex, or busts of

notable personages are surprisingly popular. More complex requests involve multi-part objects and movable parts, such as 3-D puzzles, clock gears, and even a Frankenstein head with a removable brain. Just as the librarians turned to 3-D printing for the creation of useful objects, students have also requested dice, playing card cases, phone cases, and other accessories for games.

Initially, neither Hazleton nor Wilkes-Barre considered copyright implications of 3-D printing. Students often request items that relate to popular movies, car brands, or comics. Copyright law as it relates to 3-D printing is complex and still uncharted territory, and other issues such as trademark infringement need to be considered.[8] However, websites such as Thingiverse do offer methods for removal of designs considered to be violations of intellectual property rights.

Because our students are using prints for educational purposes, and because the quality of our prints is, frankly, rudimentary, combined with the fact that we are in no position to mass produce 3-D objects, we have taken a liberal view with regards to printing these types of objects.

Assessment

After the trial periods, both campuses were able to start thinking about assessment, and began keeping track of print requests only recently. In addition to number of prints, it is important to account for print times. Supply costs are minimal. In an effort to obtain more information, both campuses are collecting data about student 3-D print jobs. Data elements include type of file, software time estimate, actual time, and weight of material. Both campuses follow up each print request with a survey that asks questions about student expectations and satisfaction.

What's next?

The 3-D printing programs at Hazleton and Wilkes-Barre have prompted discussion about expanding technologies to create a more complete makerspace. Other equipment may include additional 3-D printers

and scanners, a sewing machine, electronic cutting machines such as the Cricut and the Cameo Silhouette.

At Wilkes-Barre, the Engineering Department has purchased a Glowforge 3-D laser cutter, and if it is heavily used, the library may consider a similar purchase. The administration at the Wilkes-Barre campus requested that the library staff offer workshops in the spring related to basic 3-D printer use and design. Hazleton also plans to offer this type of training.

Conclusion

Initiating a 3-D printing program at Penn State-Hazleton and Penn State-Wilkes-Barre was straightforward, required relatively low overhead, and was an effective outreach tool for the libraries. It enhances the students' academic experience by exposing them to an emerging technology. For faculty, the use of 3-D printed objects expands the tools available for curricular development. And for librarians, the experience is positive on a personal level, increasing the librarians' skillset, but also benefits the library as place by engaging the campus community.

Notes

1. Amy Van Epps, Davin Huston, John Sherrill, Ann Alvar, and Anna Bowen, "How 3D printers support teaching in engineering, technology and beyond," *Bulletin of the Association for Information Science and Technology* 42, no. 1 (2015): 16-20.

2. Canva, www.canva.com.

3. Thingiverse, www.thingiverse.com.

4. Tinkercad, www.tinkercad.com.

5. AutoDesk Meshmixer, www.meshmixer. com.

6. SolidWorks, www.solidworks.com.

7. AutoDesk AutoCad, https://www.auto desk.com.

8. Michael Weinberg, "What's the Deal with Copyright and 3D Printing," *Public Knowledge,* January 2013, https://www. publicknowledge.org/files/What's%20 the%20Deal%20with%20Copyright_%20Final %20version2.pdf. �