Makers in the library: Case studies of 3d printers and maker spaces in library settings

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Abstract:

Purpose
– The purpose of this paper is to describe the implementation of 3D printing and maker spaces in various library settings. Insights, challenges, successes, projects as well as recommendations will be shared. Commonalities across libraries 3D printing technologies and maker space learning areas will also explored.

Design/methodology/approach
– This paper delves into six case studies of librarians that have implemented 3D printers and/or maker spaces in their libraries. The case studies focus on libraries at three different levels: school, public, and higher education with two case studies from each type. The author of this paper will describe the cases, projects, challenges, successes, along with other aspects of 3D printer, and maker space integration.

Findings
– 3D printing and maker spaces, while very popular in the field of librarianship can be incredibly exciting to implement but they come with challenges and successes just like any type of new technology. Librarians have to be fearless in implementing this technology, willing to learn on their feet, and be excited to explore.

Originality/value
– At this time most publications on 3D printing are held in the realm of popular publications (blogs, magazines, zines, etc.). Very little has been written on a wider range of case studies where 3D printers and maker spaces have been integrated into libraries of various types. This paper sets the foundation for further exploration in how 3D printing and maker spaces could be a part of library services.

Keywords: School libraries | Academic libraries | Public libraries | 3D printing | 3D technology | Maker spaces

Introduction

3D printers and maker spaces are very popular topics for libraries and library services. They are seen as taking the next step toward meeting patron needs as well as a technology and space for engaging curiosity, creativity, and collaboration. While maker spaces and 3D technologies are exciting they also come with their own challenges and successes as can be the case with any new type of technology. There might be questions to ask before implementing this technology or type of learning space. How would 3D printing work in my library? How do we staff the maker space area? Does anyone know how to work a 3D printer? What is 3D printing? What exactly is a maker space?

3D printing allows users to create physical objects out of digital ideas. This type of printing lets a creator or maker use a digital file to make or create an object they then can hold in their hand (Kaur, 2012). There are multiple types of 3D printers available for users but often they fall into three main categories. Fused Deposition Modeling (FDM) printers, which are the most popular at this time, are ones where a plastic is melted and cooled to build an item layer by layer. Stereolithography printers are those where ultraviolet light is used to harden the model while it is in a pool of photosensitive liquid. The third type of 3D printer is called selective laser sintering where powders and lasers are used to create models instead of the liquids used in sterolithography (Jamaluddin, 2013). The needs of the patrons in the library will help guide you in which type of 3D printer might be right for you. FDM printers such as MakerBot Replicators are the most popular for libraries simply because they are the easiest to set up and use.

A maker space is a location where students and patrons can create, craft, solve problems, and develop new skills (Preddy, 2013). They are also a location where users can learn through experimentation and play. Maker spaces are places where library clients can come together to share, collaborate, and explore (Britton, 2012). No one maker space is the same. Some of these learning spaces are focussed on technology where programming, hacking, music recording, and design are the norm. Other maker spaces are dedicated to crafting and arts where patrons will knit, sew, paint, and create ingenious items from weeded books. Many maker spaces include both where Monday the library will offer a workshop on bike repair, while Wednesday will have a class on music recording, and for Friday the librarians will teach about the uses of the 3D printer. There is a fearlessness required in working with these spaces, being open to offering new classes, making new connections in the community, and working with new technologies. It can be a little daunting but incredibly exciting.

Review of literature

Research on 3D printers and maker spaces in libraries to date is limited. At this time the topic of 3D printers and maker spaces is covered in popular sectors such as blogs, magazines, and trade publications. This is a newer technology to the field of library science and while the idea of maker areas, learning labs, and crafting is not new to libraries, research on the actual topic of maker spaces is still modest.

Groenendyk and Gallant (2013) detail their pilot project at the Dalhousie University Libraries. The authors discuss the purchase of a 3D printer and scanner as well as the challenges in maintaining and using these technologies. With the pilot project at Dalhousie, location of the printer is a concern as well as working with the 3D technology. There can be a learning curve in using 3D printers and scanners and while the amount of videos, blogs, and online chats are growing, gaining an education in 3D printing is still limited. Groenendyk and Gallant also focus on staff training and the deployment of 3D services at their library. Some of the challenges faced included patron use. Students and faculty who are not used to printing in 3D may have complications in understanding design for this type of printer. This is where patron education and training come in. User inexperience means that workshops, online tutorials, handouts, and overall information are important for their learning curve with this new technology. Without some type of instruction the authors recognize that user inexperience will limit the use of the 3D printers and scanners in the Dalhousie Library.

Massis (2013) offers a literature review on the topic of 3D printing the library is his article, "What's new in libraries: 3D printing and the library." 3D printing is defined; legal issues as well as the intellectual property discussions are also included in this article. Massis reflects on how the library is past being just a collection for the public, libraries are in a position to offer services where patrons can create ideas. In other words the library is not just a place to absorb or take information but to create opportunities where their clients can actually make and give back.

In her book *Makerspaces: Top Trailblazing Projects*, Caitlin A. Bagley (2014) focusses on libraries and librarians of different types across the USA that offer maker space opportunities to their patrons. Starting with a definition of a maker space, Bagley soon moves into the question of whether a maker space is right for every library. While discussing the popularity of maker centers, as with any technology or learning opportunity, she recommends paying attention to the needs of patrons and what is needed for a library setting. Library maker spaces in this case study publication vary across the country, some of which include: Anchorage Public Library, Georgia Tech University, and Urbana Free Library. Unfortunately no public school libraries are included in this monograph but the continuously growing, after-school group Michigan Makers has a chapter and provides a school-age perspective.

Britton (2012), Koerber (2012), and Britton and Considine (2012) discuss the making of maker spaces, self-publishing, and maker culture, as well as collaboration in maker spaces in their three part online article for the *Library Journal*. Focussing on maker location in public libraries Britton, Koerber, and Considine explore what maker spaces are and what they can offer library clientele. Maker spaces are a location to play, explore, and to create. They reiterate what other authors have stated, the point that no maker space is the same as another, there are no hard rules for what a maker area should be or what it should look like. Many maker areas have 3D printers but that type of technology is not required. The staff and faculty at every library with a maker space have their own perspective and flavor, focussed on the needs of their patrons. The authors explore libraries such as the Fayetteville Free Library, the first public library to have a maker space, and the Westport Public Library in Connecticut.

Maker spaces and the use of technologies such as 3D printers take planning and training. These are not standard library services, at this time, as is apparent from listening to those in the

profession who have already integrated these learning spaces and technologies into their libraries. Emerging technologies and trends are ever-changing and always present in the field of librarianship. Seeing what services are best for library patrons and what can be maintained by the library staff and faculty is of great importance.

Methodology

This paper reports the cases of six in-depth interviews with people who work at libraries where maker spaces and/or 3D printers have been implemented. Librarians and libraries at the K-12 school, public, university levels have been included for a more full representation of 3D printers, and maker spaces and their implementation in multiple types and levels of libraries. Names of librarians and their libraries are shared in this paper as explained and accepted through internal review board documentation and approval for this research. A convenience sampling was used for this research, speaking with the librarians who volunteered and had 3D printers and/or maker spaces in their libraries. Interviews were conducted via Skype online chat service, Google Hangout, or phone. All interviews were audio-recorded and transcribed verbatim. Participants knew from the recruitment protocol focus of the interviews was based on their library maker spaces, 3D printers, successes, challenges, and projects. The first question always asked was, "do you have 3D Printers in your library or learning space? If so how many?" From there participants received questions on their maker spaces, how long 3D printers and maker areas had been a part of their libraries, training techniques, funding, challenges, and successes with the technology and learning space, as well as favorite projects and products.

Case studies

David C. Barrow Elementary School, Athens, Georgia

> I love the library to be a space where kids create content and get it out to an authentic audience just as much as consuming information and stories and with it (3D Printing) being such a cutting edge technology and something that you are hearing more and more about, it seems like every day now there is some article coming out about something that 3D printers have done to improve people's lives […] but I wanted my kids to experience that cutting edge technology in something that maybe will be just a natural part of their lives in the future (Andy Plemmons, Librarian, David C. Barrow Elementary School).

The faculty at David C. Barrow Elementary School serves approximately 530 students in pre K-fifth grade. They have the full spectrum of socioeconomic levels and serve the five-points area of Athens as well as two of the most impoverished areas of the county. The school also serves students whose families are living in family housing at the University of Georgia, so they have several international students who speak other languages. Barrow is on the south end of the University of Georgia and has many UGA mentors as well as UGA classes who work with the students. Athens, GA has been described as more suburban than urban.

This elementary school has one librarian and his name is Andy Plemmons. At this time Plemmons has one 3D printer that he received in November, 2013 and while he does not have a maker space designated, the maker philosophy is a component of this library curriculum. Andy

works with the students and faculty in training on the 3D printer and works diligently to integrate the technology into the school curriculum. Favorite projects so far include creating gems with a third-grade class while studying rocks and minerals as well as creating charms on the printer for rainbow loom bracelets that will be sent to children in other countries.

A major challenge for Plemmons so far has been time with the printing process. Since he is the only librarian for the school and because he is supervising the 3D printing process with the students, his time is taken up with this new technology. If a class has 25 projects to be printed then he is supervising all of them. 3D technology is amazing for making the imagined real and for creating the opportunity for student designs to become tangible models but it is time consuming. If a print is small it takes less time, larger ones obviously take more time. There is also the challenge of printing in itself. Not every print comes out perfect the first time. Andy has a box of print fails for students to observe, learn from, as well as discuss the process for success with the next print.

The successes certainly outweigh the challenges. Plemmons has worked with many students, teachers, and classes with the new 3D technology. Students are really excited and want to see their designs come into reality. Maker spaces and the integration of 3D printing offer the opportunity for students to think critically and problem solve. These technologies and spaces engage students with possibilities for hands-on experimentation (Fisher, 2012). With any new technology or learning space, challenges will arise but as Plemmons is showing, the winning overrules any type of loss.

Van Meter Community School, Van Meter, Iowa

> I think that the innovation that it (printers and maker spaces) brings, just connecting them, once again, to that sense that they can be engineers, and they can be artists, and creators and also just bringing the sense of community to the kids. If you have kids around the printer they're all so excited, all rooting for each other that sense of community […]. That you can see that positive and that's a big thing at our school, that collaboration and being connected and creating together (Shannon Miller, Van Meter Community School).

Van Meter Community School is a public K-12, rural school. The faculty in Van Meter works with approximately 600 students. They have one librarian and her name is Shannon Miller. The library at this time in Van Meter is essentially two classrooms put together with an office in the middle. The school is currently under renovations however and the new library will have a room basically with three walls and glass sliding wall. This part of the library, the maker space, and the glass wall will make for prime viewing opportunities for the students and staff when working on maker projects as well as with the 3D printer.

Miller has a background in art so the idea of a maker space in the library has always been the norm. Long before the maker areas and libraries became popular she was already crafting, building with legos, creating videos, and more with her students. Now with the inclusion of a 3D printer in early 2014, received with a Donor's Choose grant, she can take her maker space and library even further. Popular projects in her library include fractured fairy tales where students

are creating their own stories and characters for those tales on the 3D printer. This project is based off of Carla Diana and her book *Leo the Maker Prince*, Diana being an author who Skyped in to read her story to a group of Miller's students. Shannon has fifth grade students who are studying the Olympics and creating symbols to represent this event on the 3D printer. She is also working with Andy Plemmons at David C. Barrow Elementary School to create rainbow loom bracelets and charms on the printer that will be sent to young people in other countries. So not only are these projects taking place in Miller's library at Van Meter but collaborative projects are occurring nationally and internationally as well.

Challenges that have emerged at this time involve the technology and its popularity. Miller can already tell that there is a need to purchase another printer. It seems that one printer for 600 students, teachers, administrators, visiting parents, and others is simply not enough. The technology has created its own challenge by being so popular and interesting.

Implementing this technology into the library and maker area has had very positive results. Again, as with Andy Plemmons, any possible challenges are overcome by the successes. Students enjoy seeing their projects and ideas become reality and teachers, administrators, and parents enjoy seeing the young people working with this new and exciting technology.

Richland Public Library: Main Branch, Columbia, South Carolina

> Anytime that the kids can go in there and create something of their own will, there are a lot of kids who need very specific assistance and we walk them through the steps but once somebody has just walked in and gone through that already and they find what they want to print and take care of it themselves it is pretty exciting (Jennifer Naimzadeh, Richland Public Library, Main Branch).

The Richland Public Library has 11 different locations in Columbia, South Carolina. Richland Public Library's Main Branch is located in downtown Columbia and serves a wide population of patrons including nearby college students from the University of South Carolina, local business owners, as well as the public at large. This branch also has children's and teen areas and within the teen center is the Creative Lab maker area specifically geared toward young adults.

The Creative Lab has two 3D printers, Makerbot Replicator Ones, a recording studio for sound and music, computers with Adobe Creative Suite, traditional art supplies, and Ready Animator for stop motion style filming. The maker space opened in July 2013 and has been very popular with teen patrons. At this time workshops and projects in the Creative Lab include 3D design workshops where young people were introduced to Tinkercad, a 3D designing online site. Naimzadeh and her staff have also offered workshops in Photoshop and Adobe Illustrator. Recently they also shared a workshop on Draw my Life where young people created their own animated narration video.

Challenges for the Creative Lab mainly reside with the technology. The 3D printers specifically can be finicky and require a lot of maintenance. 3D printing does not always work perfectly and can take a long time. Those elements combined can make for a frustrating experience, especially for some of the younger customers who want something quickly. This type of printing can also

have errors and when a young patron is patient, waits, and the print comes out wrong that can be upsetting as well. In general though the teens and young adults understand, especially when they realize this is a new technology.

Maker culture is very much about breaking something down and building it back up. Taking an idea and seeing where it can go (De Monchaux, 2014). The Creative Lab is offering opportunities to young people to create, build up, break down, and if necessary, try again. This experience in problem solving and exploration can be incredibly exciting.

Detroit Public Library: Main Branch, Detroit, Michigan

> Libraries aren't just about books; they're about learning and literacies of all sorts. I think that this is just a different avenue to have learning but I think it's good because it exposes the teens to these newer technologies early on so if they then go on to college and there's a 3D printer or a robotics workshop or something they can say oh yea I've done that before (Steve Teeri, Detroit Public Library, Main Branch).

The Detroit Public Library's Main Branch opened in 1921 and is located in midtown Detroit near Wayne State University. They offer a wide range of patron services including book clubs, libraries on wheels, book signings, and for their teen clients The Hype Teen Center. Hype is the name of the maker space, a mobile learning area in the teen section of the library specifically aimed at young adults. The director of Hype is Steve Teeri.

The Hype Teen Center includes one 3D printer, equipment for soldering, art supplies, technology for music production, minecraft, video game programming, as well as material and yarn for knitting, sewing, and clothing design. Since their maker learning area opened in June, 2012 the staff at the Detroit Public Library, in partnership with many community members, have offered a multitude of workshops. Some of the classes offered so far include bike repair and maintenance, Arduino and robot building, computer programming, 3D printing and design, silk-screen t-shirts, and clothing design. One of the favorite projects to date includes working with the teen patrons in the making of Arduino Robots. During Maker Faire Detroit the Hype Center's teens had a robot petting zoo. This was essentially a little farm scene with Popsicle stick fences and a little barn that had a number of robots walking around. The library staff and participating teens invited people to pick up and pet the robots.

Challenges for the staff maintaining the Hype Teen Center tend to be in three major areas, funding, staffing, and space. The Center was funded by a grant to get it started and with Detroit's Public Library system being in the middle of budget cuts year after year, funding is the number one issue at this time. Staffing can be an issue as well because no one person has the full time job of running the teen center, so it is shared among many. Finding members of the community to teach classes like bike repair and computer programming, is a time consuming endeavor as well. There is a problem with space because the teen area of the library is fixed; there really is not a designated maker space within the Detroit Library Main Branch. When a class is being offered or when students are working with the technology, items are pulled from a storage closet where everything is kept. It works but it is not ideal.

Librarians deciding to incorporate the maker space idea into their libraries have to be ready for change. The maker mentality is focussed on exploration and creativity, which might be a change for some librarians (Peppler and Bender, 2013). An alteration in patron services, library agendas, and the use of the library space may be daunting for some. It can be the right avenue for some librarians and their library space and not for others. Those who try their hand in maker spaces will admit there are challenges, but great rewards as well.

Valdosta State University, Valdosta, Georgia

> The printers have been going like gang busters, everybody is interested in them. The minute I moved the printers down to media, every time I was down there working on them, everybody who saw them asked about them, was interested in them, wanted to know how they could use them, what type of stuff they could use it for. Now that we have them, we started it in January, and we've already had to buy another printer to keep up the demand (Michael Holt, Valdosta State University).

Valdosta State University has a wide range of university students from undergraduate to the doctorate level in Valdosta, a city in southern Georgia. Media services, a part of Valdosta States' Odum Library, has three 3D printers two of which reside in the library and one in the maker space. The Valdosta maker learning area is focussed on collaborative technology, in reality it is more of a hacker space. Hacker spaces are learning locations focussed in hardware and software and how these items can aid in creativity, collaboration, and exploration (Groenendyk and Gallant, 2013). The Valdosta maker space started off as a pilot program in January, 2013, once technology was obtained, tried, and experimented with it was rolled out of student use. It took a year, until January 2014, to really get down the space policies and procedures, learn the ins and outs of the machines, as well as make sure that staff, faculty, and student assistants could maintain them properly. The man in charge of maintaining, running, and scheduling the maker space area for Valdosta is Michael Holt.

The faculty working with the Valdosta maker space present classes and workshops connected to class curricula. The basics of 3D printing and design have been taught for students in the sciences and engineering. A chemistry class produced prototypes of testing equipment, the students had to 3D print tools for a chemistry lab that they created themselves. Holt has other events planned for the maker area. He is working closely with the student group The Association for Computer Machinery for computer science majors at the university and Holt helps them with programming competition practice. Michael also is planning a "capture the flag" hacking event, where students attempt to crack or defend, depending on their assigned role, software or networks against hacking and other security breaches.

Challenges of maintaining the maker space at Valdosta University boils down to policies and procedures. Holt discussed how it took a full year to get their policies correct and he knows that there is still no such thing as the perfect policy or procedure. Working with 3D printing, and the types of technology inherent to maker spaces are typically not intuitive technologies. There is commonly a learning curve. Training is important, policies, as well as procedures at the university level, can be extremely important for this type of learning space and for these kinds of technologies to function well in a library setting.

University of Michigan (UM), Ann Arbor, Michigan

> At that time we saw this technology as it was just coming out […] and so we thought that this would be really exciting because we were doing a lot of virtual reality, digitization, and digital 3D models, things like that. So we were like, well that's not always a solution for people, you can't always get everything that you need out of a digital model or at least viewing it on a screen so we started looking at this as a possibility for another venue to display your work or to get some insight into a design (Eric Maslowski, UM).

The UM serves a student body of over 45,000 students and is located in Ann, Arbor, Michigan. It is the state's oldest university. Within their Digital Media Commons, the UM Library hosts a 3D Lab, which offers such services as 3D printing, rapid prototyping, motion capture, and 3D scanning. The staff and faculty of the UM 3D lab have been offering these types of services longer than anyone else in this research study. The UM library has had 3D printers for just over ten years and the 3D Lab had early service offerings dating back to 2002. The manager and technical creative consultant for this space is Eric Maslowski.

Similar to Valdosta, classes and workshops are geared toward the university curricula and its students and faculty's needs. Art students have used the lab to create pieces for their master's theses and engineering students have incorporated the space for models and design in their field. A favorite project of Eric's includes working with the UM Medical School and making a mold of children's noses. This gave surgeons a practicing tool to remove or extract peanuts from children's noses because apparently kids cram everything they can up their nose and in their ears. Previously the surgeons could only practice on adult noses because that is all they had access to. To be of assistance the UM 3D Lab staff extracted a nose and all the nasal cavities from an MRI scan of a child, made a mold, and now surgeons can practice with tiny 3D model noses until they get the procedures right.

Since the UM 3D Lab and staff have over ten years of experience they can discuss the successes and challenges of a 3D lab and maker space at length. There are two main challenges at this time; the largest one being keeping up with the demand. Having been in the business of 3D printing for over ten years has created a high need for the space and technology. The second challenge focusses on patron training, making sure that users who are submitting and designing models know what constitutes a good vs a bad model. 3D printing, scanning, and rapid prototyping are not the most intuitive of technologies, effective patron training, or having student assistants or staff available is very important to maker space success. It can be difficult to always have a person on hand for assistance in an open lab but students who are well educated in the use of the technology will know how to manage on their own.

Recommendations

While many librarians are thinking on the possibilities of adding maker spaces and 3D printers to their libraries, there are items to consider. The interesting thing about labs and maker spaces are that they are reasonably cheap to try out and experiment with. One of the main considerations that hold librarians back is the idea of what patrons should be allowed to do in the space. It can

be freeing that the maker culture is open and experimental. But when maker areas and 3D technologies are implemented into libraries there often need to be some rules, policies, agreements, and training.

Staff and faculty training

> Training was entirely provided by the School of Hard Knocks. Trial and error, of course we would go online and look at documentation and what other people had used, that kind of stuff but I am entirely self-taught on these printers (Michael Holt, Valdosta University).

Trial and error, experimentation, going with the flow, patience, and time were common descriptors among the case study participants when it came to describing their training with 3D printers and in creating maker spaces. Some librarians found peers on social media such as Twitter to have conversations or set up a personal learning network about making 3D models, best web sites, and tools. Other librarians visited local museums, maker or hacker spaces, libraries, and schools to see how maker areas and 3D printers worked and could be integrated into a library. Peer to peer training was very popular, experimentation, and being willing to try things out was crucial.

The important thing is to have a person or group where discussions can take place and questions can be answered. This is rarely the type of technology which a library or school down the street will have the same. Sometimes the library or school where you work for may be the only one in a city, district, or even a state, with a maker space or 3D printer at this time. While this technology is becoming more prevalent, having a spirit of investigation and little fear of failure is important.

Patron education

> Educating them on proper modeling techniques, what qualities need to be in the model for it to be able to print successfully, what can be automatically fixed, and what's going to require manual intervention, all of these things are probably the biggest challenge (Eric Maslowski, University of Michigan).

Students and patrons using 3D printers along with the other types of technologies prevalent in maker learning spaces will need to be educated in how to use them. Most librarians in this case study research train patrons in a face to face environment with classes, lectures, or workshops. A few have an online presence where they have created web tutorials, videos, web sites, and user agreement forms. As with every aspect of the implementation looking at the patrons, their needs, and what would best fit. In the case of Detroit Public Library they knew that charging teens any money for a workshop would exclude participants, in reaction to that situation, all workshops are free so that all young people who want to attend can take part. Richland Public Library's brand is "access freely" in other words they do not charge for anything. This includes printing, computer access, 3D printing, classes, workshops, and more. These two libraries took into account the needs of their patrons, how best to serve, and acted accordingly.

Funding and planning

> We really talked about it (Hype Teen Center) for about a year and a half and we did some one off workshops in that time and we just kept saying well what would fit, what's appropriate, how often would we do it. Then we got funding right around December, 2012 and then it was another six months of planning and purchasing of equipment and then in June in 2012 we finally opened for business with our first weekly workshops (Steve Teeri, Detroit Public Library).

The school and public librarians who took part in this study gained funding for their maker spaces or 3D printers in full or at least partially with grants. Other monies were provided with school budgets, foundational funding, taxes, and friends of the library groups. Both academic libraries had their maker areas and the connecting technology built into the media services or library budget. In going forward though once funding has been gained, future funding has to be considered to keep a maker space running, a 3D printer with filament, and supplies available for patron use.

This takes us into the conversation of planning. Some librarians planned for years before implementing maker learning areas and the technologies therein, while others started planning once they knew the grant had been received and the 3D printer was coming. No matter how it occurs some planning will need to take place. Questions that have been asked: What are the hours of the maker space? How will it be staffed? Can patrons use the technology in the maker space on their own or is there always a staff, faculty member, or student assistant available? Will we have a user agreement? Should patrons be trained before using the technologies? Of course there are many other questions relevant to specific libraries and the patron's needs.

Conclusion

Librarians and libraries commonly contribute to student and patron learning in and outside of the library. The wonderful thing about maker spaces, 3D printers, and similar technologies is that they can be low on cost, create opportunities for interactions with technology, and allow anyone to become a maker, to look and potentially work with and solve real-life problems (Fisher, 2012). Creating maker spaces for patrons and students confirms the understanding that libraries exist to support the creation of knowledge and learning (Turner *et al.*, 2013). Though reasonably new for librarians and their libraries, these learning spaces offer so many opportunities for patrons to grow, collaborate, learn, and explore.

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Further Reading

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2. Kurt, L. and Colgrove, T. (2012), "3D printers in the library: toward a fablab in the academic library", ACRL TechConnect, available at: http://acrl.ala.org/techconnect/?p=1403 (accessed April 2, 2014). [Google Scholar]