



## **3D Printing for Middle School Outreach: A collaboration between the science library and the Society of Women Engineers**

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Erin R. Winick is a 3rd year undergraduate Mechanical Engineering student at the University of Florida. She is serving as the President of the University of Florida chapter of the Society of Women Engineers (SWE) for the 2014-2015 school year. She also serves on the national SWE Program and Development Grants Committee. Erin interned this past summer with Solar Turbines: A Caterpillar Company in San Diego, CA and worked with investigating the manufacturing applications of mixed media 3D printing. She will be interning with John Deere this summer.

# **3D Printing for Middle School Outreach: A collaboration between the science library and the Society of Women Engineers**

## **Abstract**

3D printing is rapidly becoming an essential skill for engineering students as reliable printers become affordable for educational use. Engineering students are trained to use common CAD design software but, through 3D printing, students can immediately evaluate the validity of their design and iterate as appropriate to reach the desired functionality. To meet this need, the University of Florida Marston Science Library (MSL) opened a public 3D print lab in April 2014.

The engineering librarians were approached by the University of Florida (UF) student chapter of the Society of Women Engineers (SWE) to collaborate in their spring 2015 outreach to middle school students. This annual outreach initiative introduces budding scientists to engineering through tours of campus labs, exposure to new technologies, and engaging workshops. The UF SWE chapter aims to introduce these crucial engineering technologies at a young age (especially to girls), and spark interest in these areas to help them consider engineering as a possible career path. The library workshops introduced students to the entire 3D design cycle from modeling to production, and concluded by printing a model that they designed. The librarians and SWE representatives co-taught a basic design program, Tinkercad, along with providing design advice and a primer about 3D printing technology. The workshop was based upon general workshops that the library provides to the UF community but was targeted at immediate success for a middle school audience.

The learning objectives for the students were to leave the workshop familiar with 3D design and the knowhow to create and evaluate a 3D model that is suitable for printing. The initial workshop included male and female students and the second (offered in conjunction with UF SWE's Introduce a Girl to Engineering Day) was exclusively female. The mission of this UF SWE outreach was to target improving upon girls' spatial visualization skills, an area in which girls often fall behind, but is crucial for many engineering fields. An additional goal was that these students continue to refine and expand their modeling expertise through continued access to the UF library 3D printers.

This paper provides a brief background of MSL's 3D printing service and the libraries collaboration with student organizations; tips on engagement of different audiences with this new service; and the real-world use case of middle school outreach.

## **Background**

The Marston Science Library at the University of Florida has offered a 3D printing service since April 2014, and published suggestions for funding and establishing a service in other libraries (including staffing, addressing environmental safety concerns, and levels of service)<sup>1</sup>. It is important to note that the 3D printing service is completely open to not only all members of the university, but to the general public as well. The service, initially implemented at MSL and the Health Science Center Library, has been very successful leading to an expansion to the

Education Library in January 2015. It offers new and different ways to interact with library users and provide outreach, both at the University and out in the community.

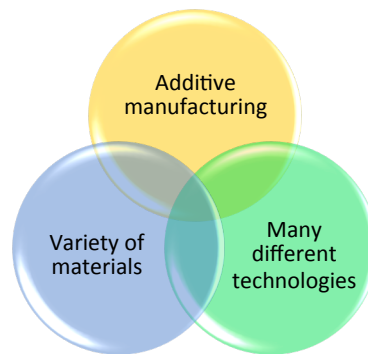
The UF Libraries also have a history of collaboration with student groups (ranging from formal to informal) as a means of outreach and include the Freshmen Leadership Council, Students for Free Culture, and Humans vs. Zombies just to name a few <sup>2</sup>. These collaborative outreach initiatives often targeted UF students and included activities meant to engage students in one or more of the three categories of 21<sup>st</sup> Century Skills: Learning and Innovation; Information, Media, & Technology Literacy; and Life & Career <sup>3</sup>. Although the mission is still the same, the partnership with UF SWE is unique in that the primary audience is middle school students.

### 3D Printing as Outreach

In addition to the mechanics of the printing operation, our service includes several components that mimic other, more traditional aspects of public service with which librarians are very familiar: repeated explanations of the basic service, development of an online guide (<http://guides.uflib.ufl.edu/3dprinter>), the reference interview to accompany each submission, and instruction sessions. As is typical with other library services, one-on-one explanations must be available during most of the library's operating hours, but larger and targeted audiences can be reached through instruction workshops.

At this point, these workshops are primarily introductory in nature and follow a general framework. The concepts commonly emphasized during these workshops include:

*What is 3D printing?*



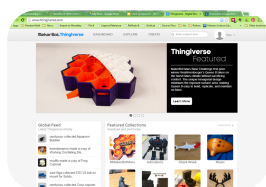
*Types of printers:*

- There are many types of 3D printers, but we only have one type in the library.
- A typical 3D printer can only handle one or a limited type of filament, such as plastic *or* chocolate.
- Not every 3D printer can print every 3D model successfully.

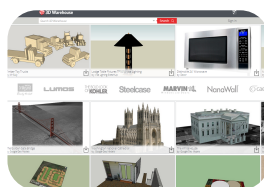


*Ways to find a model to print:*

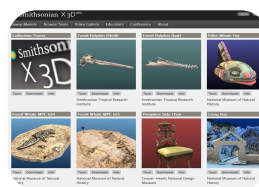
- Select from a library of models, such as Thingiverse.com or the Smithsonian’s X 3D.
- Draft your own model or customize by using modeling software.
- Scan from an existing object, using a 3D scanner or by uploading many photos to create a model.



Thingiverse



Trimble 3D



Smithsonian

<b>Simple:</b>	•Tinkercad, 123D Capture/Make
<b>Medium:</b>	•Sketchup
<b>Complex:</b>	•Solidworks, Inventor, AutoCAD, Blender, Maya
<b>Remember</b>	•Not all software is designed for 3D printing

We cover other topics such as modeling basics at different levels, depending on the audience. More recently, local use cases have been incorporated to illustrate applications of the service and convey success stories. These have proven quite engaging.

### Engagement of Audiences at Different Levels

During the first eight months of offering a 3D printing service, the librarians have been invited to present workshops to a wide range of audiences. These sessions happen at the library, on campus, and off campus (and yes, the 3D printer travels to these locations!). Past audiences include university faculty, staff, and students; library staff and a local retirement community that is associated with the University.

Rather than reinventing the teaching outline each time, a knowledgebase (in the form of a shared network folder) was created from which we select the examples and areas of emphasis for each new workshop. For each type of audience, we select which components to address, how much time to spend on each component, and the balance of delivery from lecture/demo to video presentations to hands-on practice for each component. With each new group, our confidence in selecting the emphasis for each component improves. The table below details the framework that is used for these sessions, the general components included in sessions, and the various audience levels.

		Components					
		<i>types of printers</i>	<i>how it works</i>	<i>applications</i>	<i>modeling demo</i>	<i>hands-on modeling</i>	<i>library service</i>
Audience	<i>community</i>	lengthy/ videos	lengthy/ videos	lengthy/ videos	brief/ video	no	brief
	<i>library staff</i>	moderate	moderate	moderate	brief/ separate	brief/ separate	lengthy
	<i>university students</i>	brief	brief	brief	moderate/ separate	no/ separate	brief
	<i>middle school</i>	brief	brief	brief	brief	lengthy	brief

In most of the workshops, librarians spend a limited amount of time on modeling basics. A video tutorial from Tinkercad.com is shown because that software has a relatively quick learning curve. We point the university community to other modeling software programs, such as Solidworks for engineers and Blender for artists. We also recommend clean-up programs such as NetFabb Basic when models exhibit flaws. Since we have not yet become expert users of modeling software, we limit our instruction and advice to match our comfort level. We hope to harness other experts, particularly among our engineering students, to provide more in-depth workshops on modeling software.

### Use Case of Middle School Students

The UF Society of Women Engineers' chapter requested the library's partnership for *SWE 3D Printing Day*, a daylong event to engage secondary students in engineering-related activities. Due to the success of the first library workshop, about six weeks later we were invited to participate in UF SWE's *Introduce a Girl to Engineering Day* – a similar event exclusively focused on girls. SWE has a history of engagement with MSL – they hold meetings in the library space and a former MSL librarian served as the group's faculty advisor – which made the partnership a logical fit for this organization.

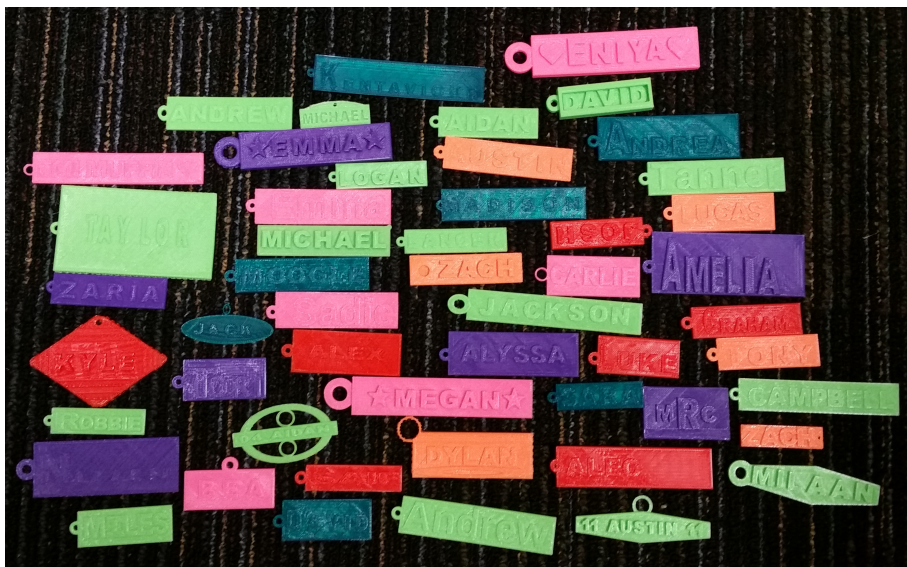
Although the first event was initially targeted to female middle school students (given the mission of SWE), it ended up encompassing a broader audience of both boys and girls. UF SWE's Outreach Chair coordinated both events in conjunction with science teachers at a local middle school. 3D printing was coupled with other fun and educational activities: constructing rollercoasters, marshmallow design challenge, building circuit boards, bottle rocket construction and a foil boat challenge.

Nearly one hundred and ten students (including ~80 girls) attended one of four hands-on sessions, which were held at MSL. The sessions were led by two to three librarians and assisted by approximately eight SWE members. We chose to use Tinkercad as the modeling program due to its usability, the fact that it is freely available, and a special feature that would appeal to this age group (the ability to download your design for Minecraft). The students were tasked with designing a nametag in order to keep the time and cost manageable (the library covered the cost of printing for these workshops).

Given the age of the students (11-13), the basic outline for 1.5-hour session was as follows:

- ~5-7 minutes on background
- ~5-7 minutes on applications
- ~20 minutes introducing the design basics of Tinkercad.com (hands-on)
- ~60 minutes for hands-on design of a nametag and for small breakout groups to see the 3D printers in action

The students were very engaged in the session and asked lots of questions during the hands-on portion. The SWE students truly complimented the librarians' skill set as many had basic if not extensive modeling software experience while the librarians possessed working knowledge of the printers. The science teachers, parent chaperons, and the children were very pleased to discover that the library is a local resource for 3D printing that is available to them. Below are just some of the tags designed by these students. Several incorporated their own creativity into the design.



When working with school groups here are a few things to consider:

- This was the first time a session was offered in the library for a non-affiliated group. As with many institutions, UF's public workstations are restricted to the university community. Consequently, guest accounts had to be created to allow the students access for the modeling activity.
- The process to create a Tinkercad account requires a Facebook or email login and a date of birth. If the individual is under the age of 13, their parents need to approve their account access. More information can be found on Tinkercad's FAQ page: <https://tinkercad.zendesk.com/hc/en-us>. A good potential solution is to have information about creating accounts distributed to parents a week before the session.
- Once students completed their design in Tinkercad, they were instructed to download it for 3D printing and email it to one of the librarians for printing. We discovered that although all students had a school email address, the school email system is a closed system and does not allow students to send email to outside email addresses. However, most students did also have personal email accounts and were able to use those to send the files.
- Many of the students quickly learned how to use Tinkercad. This was great to see!

Overall, this outreach session was deemed a success by both SWE and MSL, the benefits of which were twofold: exposing secondary students to a new technology in an engaging way and increasing the visibility of the library as a provider of innovative services to the community at large. This initial success paves the way for the library being part of this annual SWE outreach event. Additional future initiatives could include offering co-taught intermediate-level 3D printing sessions for returning students and/or expanding the program to other middle schools in the local area.

## References

1. Gonzalez, S. and D. Bennett. (Fall 2014). Planning a 3D Printing Service in an Academic Library. *Issues in Science & Technology Librarianship*. 78. DOI:10.5062/F4M043CC
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