**3D Design Certification and Assessment**

3D design and printing is an excellent way to teach technology skills, as well as get people interested in STEM careers and pathways. 3D printers are popular pieces of technology at the Ramsey County Library Maker Spaces with both adults and teens, and a good creative tool to improve not only design skills but also basic computer and internet skills. There are very few limits on what students can create with their 3D design abilities, so this assessment hopes to be broad enough to cover whatever students may design while still encompassing the various skills they should have to be successful in their 3D projects.

To begin, there are several computer and Internet skills that students need to have mastered to successfully complete a project and be able to have their 3D design printed. Those that align with other Northstar assessments and skills are listed below:

Computer and Internet Skills and Competencies:

* Demonstrate knowledge and appropriate use of mouse clicks (right-click, left-click, and double click).
* Click and drag
* Drag and drop
* Hovering over objects/icons
* Utilize common controls for screen interaction (selecting checkboxes, using drop-down menus, scrolling).
* Demonstrate knowledge of keys on keyboard (Enter, Shift, Control, Backspace, Delete, Arrow Keys, Tab, Caps Lock, Number Lock).
* Identify and make use of common website interactions (e.g., play buttons, hyperlinks).
* Demonstrate familiarity with website structure (e.g., landing pages, internal pages).
* Perform internet search using clear parameters (terms and filters).
* Identify mechanisms for storing files (flash drives, hard drives, cloud-based storage).
* Create and send an email, including recipient address, subject, and message.
* Add an attachment to an email.
* Move documents and files, including to and from the Recycle Bin.

These skills are part of the assessment process outlined at the bottom, and include the process of operating a computer, navigating to 3D design software, and getting the design file to the person who will be printing it (as at RCL we do not allow the general public to operate our 3D printers - other sites may use a different printing process). The assessment accounts for multiple 3D design submission methods, such as the students being able to put their design file onto a shared flash drive or sending the file as an attachment through email.

This assessment was made with Tinkercad in mind as the 3D design program students will be using. This is what we generally teach at the Ramsey County Libraries, but other design software can be used to accomplish the same or similar goals. The important parts of the assessment are that the student demonstrates knowledge of 3D design skills and the project is completed by the student and printable. At the end, the student should have a printed design that demonstrates that they can use the 3D design software to create a shape, make changes to the dimension of that shape, and add and subtract (using grouping, alignment, and other techniques as necessary) to and from that base shape.

3D Design Skills and Competencies:

* Open 3D design software (Tinkercad or other program)
* Create base shape/start a new project
* Design skills include some or all of the following:
	+ Adjust dimensions of shape to fit project and be printable (dimensions will depend on 3D printer being used and other site specific requirements)
	+ Add to a design (new shapes, combining shapes)
	+ Subtract from design (create a hole/cutout/indentation in design, remove unwanted shapes or parts of shapes from design)
	+ Group parts together (previous skills can demonstrate this)
	+ Align design with workplane
* Export file to print design
* Email design file or move to flash drive (virtual vs. in-person classes)
	+ For advanced students: use 3D slicing software (Cura or Makerbot Print) to finalize design for printing before submission.
* Design prints successfully (indicates proper design and file management technique used)



Potential Example Projects:





Assessment Rubric (Basic): \_\_\_\_\_\_\_\_\_/25 (score of 20 or up is passing)

| Category | Strong (5pts) | Medium (4pts) | Weak (3pts) |
| --- | --- | --- | --- |
| Computer Skills | Student is able to operate computer without assistance.  | Student requires some assistance with computer operation and/or with troubleshooting issues as they arise. | Student is unable to operate computer. |
| Internet Skills | Student is able to navigate the Internet to specific websites, search, download files, and send emails with attached files or move files to a flash drive, without assistance. | Student is able to navigate the Internet to specific websites, search, download files, and send emails with attached files or move files to a flash drive, with some assistance. | Student is unable to navigate the Internet to specific websites, search, download files, and send emails with attached files or move files to a flash drive. |
| 3D Software Usage | Student is able to utilize software to create a 3D design, without assistance. | Student is able to utilize software to create a 3D design, with some assistance. | Student is unable to utilize software to create a 3D design. |
| 3D Design | Student is able to adjust dimensions of design for printability; demonstrates ability to add to and subtract from base shapes to create new design. Design utilized more than two of the design skills, as outlined above.  | Student is able to adjust dimensions of design for printability with some assistance; demonstrates ability to add to or subtract from base shapes to create new design with some assistance.  | Student is unable to adjust dimensions of design for printability; does not demonstrate ability to add to and subtract from base shapes to create new design.  |
| Final Project | Design prints successfully. | Design has some flaws and prints with errors (pieces separate that should be grouped; was not dropped to workplane; etc.). | Design is unprintable, or no changes were made to objects/shapes to demonstrate software skills. |

Assessment Notes:

Assessment Rubric (Advanced): \_\_\_\_\_\_\_\_\_/25 (score of 20 or up is passing)

| Category | Strong (5pts) | Medium (4pts) | Weak (3pts) |
| --- | --- | --- | --- |
| Computer Skills | Student is able to operate computer without assistance.  | Student requires some assistance with computer operation and/or with troubleshooting issues as they arise. | Student is unable to operate computer. |
| Internet Skills | Student is able to navigate the Internet to specific websites, search, download files, and send emails with attached files or move files to a flash drive, without assistance. | Student is able to navigate the Internet to specific websites, search, download files, and send emails with attached files or move files to a flash drive, with some assistance. | Student is unable to navigate the Internet to specific websites, search, download files, and send emails with attached files or move files to a flash drive. |
| 3D Software Usage | Student is able to utilize software to create a 3D design, without assistance, and where possible successfully utilizes 3D slicing software. | Student is able to utilize software to create a 3D design and where possible successfully utilizes 3D slicing software, with some assistance. | Student is unable to utilize software to create a 3D design. |
| 3D Design | Student demonstrates strong skills as outlined in the basic rubric. Design showcases more complex 3D design abilities, i.e.: a design with interlocking parts, a flexi build or other movable design.  | Student demonstrates strong skills as outlined in the basic rubric. Design does not showcase more complex 3D design abilities.  | Student is unable to demonstrate strong skills as outlined in the basic rubric.  |
| Final Project | Design prints successfully. | Design has some flaws and prints with errors (pieces separate that should be grouped; was not dropped to workplane; improperly sliced). | Design is unprintable, or no changes were made to objects/shapes to demonstrate software skills. |

Assessment Notes: