Introduction

Makerspace assessment would heavily rely on formative methods of assessment. These methods of assessment include things such as projects, short write ups, question & answer, surveys, etc. The quantitative value of these assessments are low, meaning they are not graded strongly, but rather are almost like ‘participation marks.’ However, the qualitative feedback that is received from these forms of assessment can greatly help in guiding the direction/outcome of a lesson, activity, event, etc. They function as an ‘in the now’ snapshot of student’s abilities and what they take away, as well as benefit students in seeing their growth and development that isn’t just a number on a page.

The biggest facet of makerspace assessment seems to land on progress and growth. These cannot necessarily be converted to a numeric grade, nor should they be. Instead, assessing will be more superficial, and due to the nature of the space being an extra-curricular space, assessment cannot be forced either.

There are numerous types of assessment, and below will break down some examples of assessment and their possible utilities with different audiences.

Learning outcomes

Before we can look at assessment, we need to analyze learning outcomes. Learning outcomes are essentially "what do we want students/users to walk away with?" "What's their goal in the space?"

Obviously, within the makerspace, these learning outcomes are more determined by the student, and so having students formulate their own learning outcomes will be significantly important when directing learning and assessment in the space.

Some facets of "Makerspace learning outcomes can include:

- Agency
- Problem-solving skills
- Collaboration
- Creativity

https://www.edutopia.org/article/assessing-learning-maker-education

Boiling it down, students need to accountable for their own learning, but we can offer measuring tools to help see where students are learning. Essentially, students will need to rely on self-assessment for measuring their learning outcomes. This supports the agency aspect of the makerspace, and if done correctly, the assessment aspect should help support their problem-solving skills, collaboration, and creativity. Students need freedom to do so but understand that this freedom must/should have a roadmap attached to it.

Individual assessments

First Time & for small projects: This can be a very basic assessment for inexperienced users to the space, or who are newly interested in a technology that is available within the space. We will use the example of 3D printing but is overall applicable to all technologies.

1. **Exit Ticket:** this form of assessment is used as a method of direct feedback from users, and is usually just a short, open-ended question that allows the user to briefly answer and provide feedback to the Makerspace/instructor.
    - [following a tour]: "what is one technology that interests you in the space?"
        - This question can help us find out where students' interests lie in the space, and perhaps prop up, or promote technologies that are either over-utilized or under-utilized.
    - [After Printing a vanity token]: what is one thing you took away from your first time using a 3D printer?
        - This can help us discover if students are just following the guide willy-nilly, or actually learning something like "oh wow, Cura has a lot of cool features"
    - [First printing project (Small/Thingiverse)]: "what is one thing you wish to design yourself and print?"
        - This gets students to think that 3D printing has practical and creative purposes, as well as may inspire them to think bigger, and/or retain users to return and actually try these major projects.
    - The exit ticket could be scaled again to accommodate larger projects (think of Geordie or my projects) but there are other assessment tools to get a clearer snapshot of learning done.
    - The Exit ticket can be on paper or through a google forms and is generally anonymous. It can also be converted into a statistical format.

Examples: https://massteacher.org/-/media/massteacher/files/employment-licensure/ed-evaluation/ddms/editable-exit-slip-templates.pdf?la=en

2. **KWL Chart:** KWL stands for "know, want to know, learned." The know and want to know are completed prior to beginning the activity/project. It's a great tool for individuals and groups, but I will highlight on the individual aspect here.

    - **Know:** what are students coming in with? This can perhaps highlight why some argue with having to do a vanity token. They're walking in with a large knowledge of 3D printing already and forcing them to do it is like forcing a race car driver to do a basic road knowledge test. The KWL chart could be used as an alternative measure to the vanity token and allows an alternative/multiple entries of engagement/assessment. Starting every student at square 1 is a very colonial western mentality that doesn't promote what the student already knows, and perhaps discourages them instead (i.e., they may feel stupid, their knowledge is "wrong" because they use a different printing software, etc.). They may just whizz through it and leave a bad taste in their mouth. My justification for this is I have a friend who owns a small 3D printing business, and I just couldn't imagine asking him to do a vanity token before using our printers, but rather perhaps asking him KWL may help us learn something new about our machines too.
    - **Want to know:** This is the more significant aspect of the chart. It highlights why students are coming in beyond just interest. Maybe they saw something really cool online, maybe they've just had an itch to learn this technology, or maybe a professor recommended they could try it for their course projects. The want to know lets the student take charge of their learning and guide them, try things, research, etc. It is helpful to the space to see why students are coming in and wanting to 3D print.
    - **Learned:** This is the final outcome the student achieves. It's not based on their project, but on what skills they took away. Maybe they learned about new features in Cura, etc. What they learned doesn't necessarily have to be what they wanted to learn either, perhaps they learned more, or learned something different.

Example:
https://www.readwritethink.org/sites/default/files/resources/lesson_images/lesson924/kwl.pdf

3. **<u>The Big Projects:</u>** These are designed for those who are coming in to do long-haul massive projects, and they may already know everything about a specific project, but just need a space to work. Much to their surprise, they can still be assessed (mwuahaha).

    - **Project planning:** Getting people to think about their projects helps them academically, in a workplace, for submitting papers, grants, proposals, etc. The world is full of project planning, and getting to know some students, a lot of them are going into fields that need plans submitted. Getting them to do up a plan can help them follow a strategy, maintain their expectations of the project, things they may need, remembering things that could be missed, etc. They are essentially creating the Lego build guide to their project. We could have students do this as a blog post, a more formal project proposal (this could help us with approving and rejecting certain things), or just chicken scratch on a page, but the idea is to get students thinking about the steps that go into their creation, and if they had to hand over the keys to someone else, could they follow it? It further helps us to see what steps students are taking to start, work on, and complete their projects. It also helps those students (like me) who never plan to see their process in a unique way other than just the resulting project.
        - Example topic points: materials needed, technologies needed, prerequisite knowledge, places to troubleshoot/find support, some possible errors that may arise, a rough timeline, etc.
    - **Artist Statement:** For students doing more creative, less structured work, having them create an artist's statement can help them reflect on the creative aspects of their work, and help express their work to others. As a space, we can see the vision that went into the work, as well as the emotional and metacognitive connection to the work.

Groups/Club events

1. **KWL Chart:** The KWL chart is applicable to groups/club events as well, and arguably offer a good insight to those events' desired outcome(s). Club/event leaders could issue a KWL chart to see what users may be walking in with, and then scale up or draw back their workshop objective. It can also provide feedback to club/event leaders on how to gauge the success of their workshop, plan future events, and the makerspace to see how organized groups utilize our space and their takeaways.

2. **Exit tickets:** adaptable to club events as well, similar to individuals on their own.

3. **1up 1down/2 stars and a wish:** These allow students to provide feedback to the organizers, or to their peers about one good or multiple good aspects and maybe 1 or 2 areas of improvement. They allow students to take pride in their accomplishments and understand facets of improvement, but in a manner that is not hostile or destructive. Example: https://johnthebaptistcs.ie/wp-content/uploads/2020/04/Learning-and-Teaching-2-Stars-and-1-Wish.pdf

Out of the box types of assessment

1. **Gamification/tokenization:** Gamification/tokenization relies on making achievements or stages to a student's learning objectives. This can be as simple as badge collecting when they complete a new-user task of a modern technology (like a badge for completing a vanity token). It can be scaled to different achievements/badges for example helping another user, submitting a blog post, etc. Each technology can have various technologies that would needs some time to design if implemented.
   As students collect badges or such, they could be turned in to prizes perhaps, though the cost of which would need to be determined.
   The major aspect of gamification/tokenization is it incentivizes learning beyond just doing a basic task in the space. It helps offer a roadmap to success if designed properly and can be used as a sort of 'checklist of learning' and benefits the space in having a hardcopy of what students have done in the space and can also be turned into statistical data to help us see where our users are at (i.e., are 98% of our users ever progressing beyond the basics of printing a vanity token).
   Example: https://ict4kids.ca/2016/04/04/what-does-assessment-look-like-in-makerspaces/

2. **Record keeping:** Suggested by my wife, this would be an excel sheet of sorts, where we record what students are doing in the space. I think its an interesting assessment for us in terms of data collection and measuring what students are doing, but it would be of a more behind the scenes form of assessment that doesn't directly benefit students. I only included it because it seemed like a decent and private strategy to find areas of use and growth within our space.

Indigenous assessment strategies (oh yea it's all coming together)

It should be stated that assessment from an indigenous aspect is quite unique. It often avoids concepts of grades, scores, etc., because they aren't applicable to life and experience. Oral and observational learning are fundamental factors of Indigenous learning. https://www.learnalberta.ca/content/aswt/indigenous_pedagogy/documents/assessment.pdf

In many ways, self-assessment aligns perfectly with Indigenous ways of knowing, because of reflective and observational learning. However, a major aspect can also be through oral expression.

Because of how focused Indigenous tradition and ways of knowing are on oral and communicative ways of knowing, assessing from an Indigenous perspective could include utilizing our podcasting room to have students share an audio clip of their creation, other audio/video formats, creative storyboards to express their planning or outcomes, a presentation, exit tickets, or even just a good old conversation with a makerspace staff member. These forms of assessment are not just limited to assessing Indigenous users, but as well as assessing non-Indigenous users from an Indigenous perspective.

Some other aspects also include connecting it to language, identity, the land, tradition, etc. What student's put into their work within the makerspace is an expression of their identity, their knowledge, their backgrounds, etc. Its up to us to interact with students in this manner and help encourage them to promote that through simple means like a short statement piece on their work, a recording, etc. Some examples include:

- artwork/photographs
- storyboards
- presentations
- raps and poems
- reflective learning logs.

Curricular Integration

This is by far one of the largest challenges for the makerspace to currently face. “How do we provide a space for students to learn their own interests, but also integrate this within their current courses?” Some courses may have an easier time when answering this question, such as a design or arts or engineering classes, but taking my background in history, I can’t really say how I would submit something to a professor using the makerspace… and thus the challenge of curricular integration begins.

As we’ve known before, the makerspace is a space centred around learning by doing. https://thejournal.com/articles/2018/09/04/integrating-makerspaces-throughout-the-curriculum.aspx

Integrating curriculum starts with promoting learning by doing to our faculty and instructors as alternatives for major assignments. For example: as an alternative to a history essay, could I produce a 20-minute history video about the topic? Then, once support from faculty exists, how can we support students in meeting these curricular expectations? Of course, offering the tools to do so is important, but I also believe that we can help develop planning strategies similar to ones that already exist within the library system such as citation support, essay workshops, etc., but could also extend to offering names of other students within the makerspace who may be willing to offer a crash course in a subject. The makerspace does not necessarily need to offer the supplies (such as videomaking), but we should offer the knowledge, and we can use our resource of students to support this. This also highlights aspects of collaboration, planning, and social awareness of our interconnected society.

Finding options to learn by doing is by far the biggest hurdle when it comes to curricular integration, and the makerspace must function as a support to students in these situations.

Articles/notes

"In particular, there are no widely accepted means of assessing learning in makerspaces in public libraries. This is not surprising given the challenge of creating meaningful assessments in informal learning (Petrich et al., 2013)." (Cun et al.)

"Based on research into makerspaces and practices, three types of assessment tools seem to be a good fit for makerspaces: design journals, reflections, and badging. Design journal and reflective writing are two strategies that emphasis metacognition and encourage learners to self-evaluate their progress in makerspaces." ('What Does Assessment Look like in Makerspaces?')

Table 5. Assessment Types Utilized Among Makerspaces

	FULL SAMPLE (N=48)	OUT-OF-SCHOOL (N=28)	SCHOOL (N=20)
SELF-ASSESSMENT	**48.0%** ↑	36.0% ↑	65.0% ↑
PORTFOLIO ASSESSMENT	35.0% ↑	21.0%	55.0% ↑
EXIT SURVEY	33.0% ↑	32.0% ↑	**35.0%**
PEER ASSESSMENT	33.0% ↑	29.0% ↑	40.0%
RUBRICS	29.0%	7.0%	60.0% ↑
SHORT ANSWER QUESTIONS	21.0%	18.0%	25.0%
ADULT MODELING	17.0%	4.0% ↓	35.0%
PRE/POST-TESTS	10.0%	11.0%	10.0% ↓
ESSAY ITEMS	6.0% ↓	4.0% ↓	10.0% ↓
MATCHING ITEMS	2.0% ↓	0.0% ↓	5.0% ↓
MULTIPLE CHOICE	2.0% ↓	4.0% ↓	0.0% ↓

Note: Bolded percentages indicate most ↑ and least ↓ common responses.

(Peppler et al.)

https://brightclassroomideas.com/assessment-differentiated-makerspace/

https://www.futurelearn.com/info/courses/makerspaces-for-learning/0/steps/94049
https://ugc.futurelearn.com/uploads/files/0c/e3/0ce3a46f-906f-490b-8768-1a7fd5e4cf3b/z._Figure_1_step_2.8.pdf

Further Ideas/areas to examine

- how does assessment relate to managing student expectations, ideas, or discipline?
- How can we integrate more aspects of Indigenous learning outcomes/ways of assessment?
- Is there an ideal, umbrella-like assessment strategy that could work for almost all students?
- How can we engage/integrate universal design for learning and differentiated learning?
- What could we design in-house types of assessment?