

**A Suite of Tools for Educators:
Documenting and Evaluating
Student Agency
in making**

**Interviews
Reflections
Surveys
Portfolios**



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Defining “agency”

Making activities can provide opportunities for youth to direct their own learning while pursuing personal goals and interests.

Research on making education (in museums, afterschool programs, libraries, etc.) emphasizes that this **self-directed learning** is key to youth engagement and success. We understand this self-directed learning as “**agency**.”

Agency is visible when:

- Learners pursue ideas or plans with **intention and purpose** [1,2]
- Learners take **intellectual and creative risks** without a blueprint while adjusting their goals based on physical feedback and evidence [3,4]
- Learners feel like they can **affect positive change** in their lives and/or their communities [5]
- Learners feel a sense of “**perceived autonomy**” which is “The extent to which one believes that s/he has the agency to pursue his/her own STEM interests and choose his/her role in inquiry and innovation” [6]
- Learners take an “innovation stance” that involves “**Enthusiasm for new ideas and trying new ways** of doing things” [6]

How to use this resource

Youth may feel empowered by participating in making programs.

However, it can be difficult to evaluate the “who, what, when, why, and how” of student agency.

What does student agency look like as it shifts, grows, and changes?

To help educators answer this question, we compiled this suite of documentation and evaluation resources. This packet includes a variety of tools for documenting and understanding student agency. **Educators can mix-and-match these tools** to best fit their unique making contexts.

Based on our review of current making research and prior data collection experiences, we believe that **these tools should help illuminate:**

- **Changes in perspective** related to autonomy and confidence in trying new things
- The **shifting nature of design ideas** throughout a making process
- How learners believe their making processes can **impact their/others' lives.**

Before getting started...

Before getting started, it is important to **articulate your goals** in documenting and assessing agency.

What aspects of agency are you hoping to understand in your makerspace?

To figure this out, try answering the following questions:

- **Designing for agency:** How are making activities organized in your space to encourage students to take charge of their learning, their projects, and personal agency? What pedagogical strategies do you use to support youth in exploring their own interests and pathways?
- **Student project autonomy:** How do you assign projects in your space? Do your students all create the same type of project (such as a scribbling machine or marble run) and have room to make those projects their own beyond basic design differences? Do youth come up with their own project ideas from scratch with significant variation in end-results?
- **Student making processes:** How do youth pursue their project ideas? Are you a hands-off facilitator who only steps in to assist youth when they are about to quit or hurt themselves? Do you like to provide assistance along a student's entire making process? Do you give students step-by-step instructions for how to create their projects? How much control do youth have over their project-making process?
- **Relationship to community:** Are youth trying to address a specific social issue or problem with their making projects? Do projects in your space involve other people in the local community?

After answering the above questions, you may have a better sense of whether you want to see how youth:

- 1) Come up with **their own ideas** for a project,
- 2) Take **control** of their project-building process, and/or
- 3) View their projects as **impacting themselves or the world** around them.

Interviews

WHY INTERVIEWS?

Humans are storytellers. Stories can be the most powerful way to share ideas and experiences. And sometimes we learn the most about our students just from talking to them.

The following interviews can be conducted either by educators with their students, or between students as peer-to-peer interviews.

BEFORE GETTING STARTED

Consider the following questions to help identify how you want to organize and record student interviews, and ways you will make sense of them afterward:

- **Who** do you want to conduct the interviews? (Do you want educators or mentors to conduct the interviews? Or do you want learners to interview one another? Sometimes students are more comfortable talking to friends or even strangers.)
- What **tools** do you have available for recording interviews? (Audio recorders? Video cameras? Your cell phone? Tablets or computers?)
- What **medium** do you want to use to record interviews? (Do you want only audio recordings or also video recordings? Do you want students to draw pictures of their project as they describe them?)
- **When** do you want to interview students? (After completing projects? In the middle of creating a project? In the beginning and the end?)
- **What** do you want to do with the interviews once they're done? (Do you want to showcase the interviews with parents and the community? Are the interviews an opportunity for students to perform their work in formats that others can see and/or share?)

QUICK START SUGGESTION

If you are working with limited time and resources, start small. Try asking just 2 questions of each student and jotting down their answers on a piece of paper or on a computer (You can choose from the list of questions on the next page). Then, take a photo of their project to connect with each interview quote and display these in your makerspace.

Example Interview Questions

Interviewing students at the **start of a project** will give you insight into the **excitement** and sense of **ownership** a student feels. Potential interview questions about agency during the start of a project could include:

1. Describe your project idea. What are you trying to make?
2. How did you come up with this idea/project? Did anyone or anything specifically inspire you? What makes your project idea unique to you?
3. What excites you about this project?
4. Do you anticipate any challenges in making your project come to life?
5. Do you need to learn any new skills to make your project? If yes, how do you plan on learning these skills?

Asking questions **in the middle of a project** can provide insight into student agency related to: a) **questions or challenges** youth are taking on with their projects, b) whether their project focus has **changed and how they decided** on those changes, and c) the **creative risks they are taking** to achieve their goals. Potential interview questions include:

1. Describe your project. What are you making?
2. Has your project changed from your original design? If yes, in what ways? If not, why not?
3. Describe any challenges that you are dealing with, big or small. What is or was the problem? How did you, or how are you going to address that problem?
4. Describe the materials you are using for your project. Why did you choose these materials? Did you try other materials as you created your project?
5. What is your favorite part of your project so far and why? What do you want to improve about your project and why?
6. Has anything surprised you as you made this project? Why or why not?

More Example Interview Q's

Asking questions **at the end of a project** offers opportunities for reflection on **processes** that impacted students' sense of agency. Potential interview questions include:

1. Describe your project. Why did you make this specific project and how does it work?
2. Did your project change at all from your original design? If yes, how?
3. Did challenges come up as you created your project? If yes, how did you address those challenges? What different solutions did you try? Did you get help from any people or resources?
4. Did you feel like you could do whatever you wanted with your project and choose the direction of your work? Why or why not?
5. Describe the materials you used for your project. Why did you choose these materials? Did you try other materials as you created your project?
6. Did you learn anything new when making this project? Any new skills or ideas or concepts? Do you think you could teach other people what you learned?
7. Have you or will you share this project with anyone? Who? Why?
8. Do you feel proud about your project? Do you think you want to make more projects after creating this one?
9. If you made another project like this again, what would you do differently?

Example Student-to-Student Interview Guide

Tinker with the following peer-to-peer student interviews to best fit your makerspace!

Set-up:

- Put a table with two chairs in a corner of your makerspace, or outside your space if it's noisy
- Provide a list of interview questions and a recording device of your choice (e.g., pencil/paper, audio recorder, tablet, etc.)
- Offer instructions, such as asking students to pretend they are talk-show hosts recording the interview for TV

Potential Interview Script:

- Hello, and welcome to my show! I'm your host, _____. Please tell me your name!
- Describe the project you have created! How does it work? Why did you make it?
- What makes your project special to you and your own?
- Can you describe your process of making this project?
- Why did you choose these materials? Do these materials have special meaning for you?
- Describe a challenge you faced when creating your project and how you solved it. Did you learn anything new when making this project? Could you teach us what you learned?
- Have you or will you share this project with anyone? Who? Why?
- Are you proud of your project? Do you want to make more projects after this one?
- If you made another project like this again, what would you do differently?
- Thank you for joining us today! Any last words for the audience?

Additional Notes:

- For younger students, consider having just 2-3 questions in the interview and make sure they understand what the questions mean
- If you don't have digital tools for making recordings, ask students to write their interviewee's answers on index cards
- Encourage students to draw out their answers as well as explain them – sometimes it helps to illustrate how aspects of a project changed over time in addition to verbally describing them.
- Try creating a “documentation station” where students ask these (or other) questions whenever they feel interested or inspired; you can encourage students to regularly interview each other as challenges come up, or when they learn something new, etc. to highlight their unique experiences or sense of agency in the process
- When using a video camera, make sure to include students' hands and projects in the frame because many times people will gesture at different aspects of their project when explaining their processes/experiences creating them.

Reflections

Reflecting after creating a project can often be the most fruitful way to surface descriptions of agency. The following reflection questions are best suited for the end of a project-making process. These reflections can be useful for supporting portfolios as well.

CONTEXT AND FORMAT

Before starting, answer the following questions to decide your reflection context/format:

- Do you already have a regular written reflection practice in your space?
 - If your students do not regularly journal or reflect, this may be challenging. You may want to use other forms of media to capture reflections (such as audio recordings) or add visual documentation to written reflections.
 - For younger students, consider recording their reflections in audio interviews or writing down their reflections as they speak to you.
- Do you want to share these reflections with a larger community?
 - If students know that an audience will see their reflections, they may be more excited to engage in reflections.
 - If you want to showcase these reflections with the community, consider what you want that to look like. Do you want youth to create posters with images and written reflections? Do you want to share videos of youth reflecting aloud?
 - Do your youth use social media? If so, they may enjoy using platforms such as instagram for reflections. You can create a single account for your students so that everyone can post to the same account and see each other's reflections in real-time. To make instagram posts private, follow the instructions here: <https://help.instagram.com/116024195217477>. Resources such as Youtube and facebook have similar options for private sharing as well.

REFLECTION QUESTIONS

1. Describe your process of creating your project.
 1. How did you come up with your design ideas?
 2. What do you feel makes your project your own or unique?
2. When creating your project, did you have to learn new things?
 1. What did you learn, and how did you learn it?
 2. Did you like learning new things as you worked on your project?
3. Describe something you are proud of about your project and something that you feel has room for improvement.
4. Would you want to try making this same project or something similar again? Why?
5. What would you do differently if you were to make this same project again?
6. What would you want your family and friends to know about your project and how you made it?

Surveys

LEARNING FROM THE ACTIVATION LAB

While surveys don't always get at the depth of what a person is thinking or feeling, they can often be a quick way to evaluate student perspectives and experiences. Especially when comparing pre-surveys (before a making experience) to post-surveys (after a project or experience is completed), you may be able to see changes in a student's thinking or perspective about agency.

The Activation Lab (<http://www.activationlab.org>) has developed a wide range of instruments for measuring "learning activation," which includes the dispositions, practices, and knowledge enabling success in subsequent learning contexts following an initial in-depth experience involving science, technology, engineering, art, and math. We find their surveys measuring "perceived autonomy" and "innovation stance" are particularly useful for understanding agency.

Perceived autonomy refers to how youth notice there are choices to be made in learning as well as their sense of agency in making those choices. **Innovation stance** refers to a learner's excitement to try new ideas or ways of doing things.

The surveys below were originally created to be used with youth ages 10-14, either at the end of a learning experience or to compare before and after an experience. However, one should not expect to see changes in pre- and post-surveys for an experience that only involves a one-time, drop-in, short experience.

We include the survey scales and information here, but we recommend that users visit the Activation Lab website to get the most updated versions and information on these tools (<http://www.activationlab.org/tools/>).

Perceived Autonomy Survey

For each item, choose the option that **best matches** what you think and feel about making.

1. During today's activities,

	YES!	yes	no	NO!
The teacher gave me questions to investigate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I did investigations in my own way.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I decided how I spent my time during an activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The teacher assigned my activities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I followed the teacher's method for doing investigations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I came up with my own way of doing investigations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The teacher showed me the right way to investigate questions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Choose the sentence that best matches how you worked on the activities today.

I came up with my own science questions and ways to investigate them

The teacher gave me science questions and showed me how to investigate them

I don't know

3. If it were up to you, which way would you choose to work tomorrow?

I would like to come up with my own science questions and ways to investigate them

I would like the teacher to give me science questions and show me how to investigate them

I don't care

It depends

Innovation Stance Survey

For each item, choose the option that **best matches** what you think and feel about making.

Please rate these according to YES!, yes, no, NO!:

	YES!	yes	no	NO!
I like making new things even if I am not very good at it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I share my design ideas even if I am not sure they will work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I try to find new ways of doing things even if they might not work out.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I try to learn new things even if I might make mistakes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a lot of creative ideas about how to make new things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know I think differently than other people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often come up with ideas no one else has.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to use materials in ways they have never been used before.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to figure out new ways of doing things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find new ways to solve problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to make things no one has ever seen before.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a good imagination when working on projects.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Scoring Surveys

The following information can be found on the Activation Lab website (<http://www.activationlab.org/toolkit/>). The Activation Lab suggests using the following methods for scoring your students' survey responses:

- **Hand-code the survey responses.** Text responses to survey items (e.g. "YES!" or "no") need to be converted to a numeric code: "YES!" = 4, "yes" = 3, "no" = 2, and "NO!" = 1. Blank answers can be coded as "-99"; it is important to treat these blank answers as "missing data" and not as a valid response. Write the number corresponding to the answer the respondent selected for each question on the survey form
- **Set up the spreadsheet.** Your spreadsheet should have one column for the respondent ID and one column per item (for both pre and post, if applicable).
- **Enter the data.** Using the numeric scores you wrote down earlier, enter the score for each answer into the corresponding column on the spreadsheet. Each respondent gets a new row.
- **Calculate Averages.** For all survey tools are designed to be scored using the Rasch model. except the Engagement survey, All survey scales were designed to be scored using the Rasch model, so we encourage the use of programs such as ConQuest (ACER, 2007), Winsteps (Linacre, 2008), IRTpro (Cai, Thissen, & du Toit, 2011), and the R packages eRm (Mair & Hatzinger, 2007) and TAM (Kiefer, Robitzsch, & Wu, 2014). A simple alternative is to produce an overall score comprised of the simple average of the scale items (all of which are based on a 4-point Likert scale). (See paragraph below about some specific nuances for the Engagement survey.) While occasions of missing data are not problematic to both of these scoring methods, a prevalence of missing data should be resolved prior to analyses (i.e., cases with more than 50% of the items missing should be eliminated from analyses).

The engagement survey has the highest model fit when scores are calculated using a bi-factor model within confirmatory factor analysis. This provides three scores, an overall engagement score, a score for affective engagement and a score for behavioral/cognitive engagement. Pragmatically, scores can be produced from simple averages of all items (all of which are based on a 4-point Likert scale, with reverse coding for four of the items) to give an overall engagement score, or for the sub-parts the sum of items for affective engagement or behavioral/cognitive engagement. In fact, simple averages appear to have stronger predictive validity than do factor scores.

Why Portfolios?

There are a range of skills, behaviors, and attitudes that youth develop through making that cannot be easily measured through psychometric or cognitive tests [5, 7]. A student's sense of agency is one of these things.

While certain validated surveys exist that can show whether or not youth feel changes in their ability to pursue their STEM interests or try new ways of doing things (see Activation Lab surveys shared in this tool kit), no single instrument can fully describe the “how” or “what” of shifts in student agency.

Portfolios, however, serve as a valuable formative assessment measure that can capture the detail of choices youth make in their projects over time, shifts in their thinking, how they learned from missteps and redirected their work, what proved most engaging in a making process, and personal perspective/voice that is central to understanding youth agency [8].

With portfolios, youth can systematically reflect upon the various stages of their project creation process, surfacing what goals they set for themselves, whether and/or how they took on intellectual/creative risks, and where they feel their work may have impact on themselves or the community.

Portfolios: Getting Started

These portfolio guidelines build on [MakerEd's Open Portfolio resource](#). We've added our own organizational suggestions, reflection questions, and grading rubric to reflect ideas about **agency** in your making context.

Portfolios can feel intimidating: they take long-term commitment toward review and reflection. Before you and your students embark on this portfolio adventure, answer the questions at the beginning of this resource regarding your own makerspace goals (e.g., your agency-related learning goals for youth, student project autonomy, student making processes, relationship to the community, etc.).

Then, consider the following:

1) Define your audience: Who will you share the portfolios with?

Decide who will view student portfolios, and thus the format that would best support reading and interacting with them. Will students share with one another? Will they share with teachers or parents? Will portfolios be used in university or program applications? What might the benefits and limitations of this be?

2) Preparing tools for documentation

- Do you want students to capture their reflections over time in physical design notebooks, on computers, or through a social media platform?
- Do you have tools for capturing photos over time? And if yes, who will be taking those photos (you or students)? And when should photos be captured (e.g., after every meeting time, whenever students want to take pictures, etc.)?
- Do you want students to collaborate when documenting their projects? Do you want to provide opportunities for your students to peer review each other's portfolios?
- Do you want students to create portfolios that can be seen through a powerpoint presentation, on a website, or in-person?

3) Setting up routines for documentation and reflection

- In order to capture change over time, it is helpful for students to regularly reflect on their development process. Decide whether you want to have a routine reflection time for youth every time you see them, or if you want to ask them to reflect on their processes only at specific points during the week/semester/year. See this guide's "Reflections" section.
- Similarly, decide how often you want people to capture photos or videos of their projects. Will you go around the room taking photos? Or do you want students to do so on a regular basis during each meeting?

Portfolio Reflection

If you want to include written reflections with students' project documentation in portfolios, you may consider creating a specific routine for writing. Writing is not an easy skill for all people and it can take time to develop.

For younger makers, writing may still be a very new practice and reflection may be easier to capture through audio recordings or with older peers writing down what younger makers say.

For hearing-impaired students, writing may serve as the best tool.

For English Learners, writing in one's home language may be easier than trying to write in English.

Some students may feel more comfortable having a friend interview them and verbally answering these questions instead of writing down their thoughts. Consider your specific context when organizing written reflection for these portfolios.

Please see the "Reflection" section of this resource (page 9) for useful questions to ask before, during, or after projects are being made to include in students' portfolios.

Encourage students to include sketches of their project ideas and changes over time as part of the documentation of their processes.

Different Types of Portfolios

MakerEd's Open Portfolio resource (p. 6) offers valuable descriptions of different kinds of portfolios that you could make with your youth:

Type	Description	Use	Considerations
Traditional	A physical sample of one's work (e.g., artwork, images, designs, papers, work samples, and/or other artifacts), compiled over a period of time.	Often used for the purposes of assessing performance or progress, as well as for college entrance or job applications.	Given the physical nature of many of the assets included, they can be difficult to share and face limitations in today's digital age.
e-Portfolio	A collection of electronic evidence assembled and managed by an individual, usually online. Such work may include inputted text, electronic files, images, multimedia, blog entries, and hyperlinks.	Can be considered demonstrations of a maker's abilities and as platforms for self-expression. If they are online, can be maintained and shared dynamically over time.	Some e-portfolio applications permit varying degrees of audience access, which can include general posting to social media or more restricted access to personal contacts, potential employers, or admissions committees.
Processfolio	Designed to capture both the finished product as well as the process of creation over time	Can present several unique opportunities to heighten learning by making the thinking around the process of creating visible.	Puts emphasis on "process," an important aspect of learning that often goes undocumented when the focus is on finished artifacts.
Open Portfolio	An openly networked, decentralized, and distributed portfolios system in which the maker maintains control of the content and curation process. Ideally, the platform would be a highly social, open environment and be synced across mobile platforms to enable easy upload, capture, and showcase of work work-in-progress, and processes of making.	Can be a central tool for lifelong learning and a viable alternative to contemporary assessment practices, while leveraging new technologies and skills.	Open online platforms can make learning resources abundant, accessible, and visible across settings.

Key portfolio topics

The following checklist can help you and your students organize your makerspace's portfolios to address key areas related to agency. This list is open to change and interpretation depending on your specific context and making approach.

Portfolio Items	In progress	Present	NOTES
Description of project: What did you create and why?			
Description of the process: Did your original purpose for the project change at all? If yes, how and why? If not, why not?			
Did you feel like you could control the direction of your project? What impacted how much control you had over this project?			
Sketches of the initial project design with descriptions. Sketches of things that changed over time.			
Include before/in-progress/after photos of your project and why you made changes over time. Provide descriptions of those changes.			
Description of the process: What was a challenge you faced in creating your project? How did you overcome that challenge? What did you do differently to address this challenge?			
Include a photo of the challenge you faced and how you addressed it.			
Description of the process: What are you most proud of regarding your project? Why?			
Description of what you learned: Did you learn any new skills or ideas while creating your project? Did you choose to learn these new skills/ideas yourself? What were they and how did you learn them?			
Describe how you feel you can use what you learned creating this project in other areas of your life, if at all.			
Describe how you hope this project may impact other people around you.			

Citations

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7. Farrington, et al., 2012,
8. Maker Ed. (2016). *A Practical Guide to Open Portfolios*. Maker Education Initiative.

Suggested Reading

- *Maker-Centered Learning* (book published by AgencybyDesign)
- Activation Lab (<http://www.activationlab.org/>)
- Open Portfolios by MakerEd (<http://makered.org/opp/>)
- Basu, S. J., Calabrese Barton, A., Clairmont, N., & Locke, D. (2009). Developing a framework for critical science agency through case study in a conceptual physics context. *Cultural Studies of Science Education*, 4(2), 345–371. <https://doi.org/10.1007/s11422-008-9135-8>

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