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## “My Portfolio Helps My Making”

### Motivations and Mechanisms for Documenting Creative Projects

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Within the growing world of makerspaces with youth-oriented educational programs, where youth make anything from robots to costumes to digital games, much of the value of making lies in the process of creating personally and communally meaningful projects (Pepler, Halverson, & Kafai, 2016). By sharing their projects and processes, makers invite constructive feedback, communicate their maker journeys, share their efforts and struggles, and learn through planning and reflection (Tseng, 2015a). In fact, the documentation of making regained interest as makers’ portfolios became vital parts of job application and college admissions processes (Byrne & Davidson, 2015). Emerging from the arts (Gardner, 1989), portfolios serve as a response to the increased pressures of accountability, a hopeful alternative for standardized testing, and a way to provide a richer picture of student learning (Niguidula, 1993). Portfolios become valuable learning and community-building tools when they inform overall classroom community learning and allow students to take ownership over their learning (Riconscente, 2000). In makerspaces, the overwhelming majority of educators recognize both the importance of portfolios as learning tools and the difficulty of capturing making as it happens without disrupting or taking time away from the making

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(Keune, Peppler, Chang, & Regalla, 2015). This can lead to portfolios becoming an afterthought that does not evoke the excitement often connected with making.

Organizers of out-of-school spaces (e.g., after-school clubs, libraries, museums) particularly find it challenging to meaningfully integrate the documentation of hands-on projects; despite its perceived importance, documenting is tricky to implement, especially in out-of-school settings without attendance requirements. Portfolio creation to bolster college and job applications may not be sufficiently motivational for youth, as this does not directly serve their immediate project needs. It is unclear how to support the capturing and sharing of hands-on creative work in out-of-school makerspaces in a way that is purposeful and meaningful for youth. Educators need examples of youth capturing their projects on their own terms, in their own ways, and on their own time to inform out-of-school portfolio processes. This knowledge gap prompted us to ask: what are the mechanisms and motivators that make the documentation of creative projects immediately purposeful and meaningful for youth?

To answer this question, we examined the youth portfolios of an urban, out-of-school, and youth-serving makerspace in the eastern United States through a year-long qualitative study. The makerspace we worked with had a space-wide process whereby every youth had their own online portfolio. In this article, we focus on three youth who captured and shared their creative out-of-school work beyond the adult-initiated process. The three cases concretize different ways of documenting and allowed us to extract specific motivators and mechanisms that could frame portfolio creation in other out-of-school settings as immediately purposeful and meaningful for youth.

### The maker movement and portfolios

Internationally, educators have created informal networks of people interested in and supportive of learning through personally meaningful projects within workshops for exploratory tinkering with tools from looms to laser-cutters (Peppler & Bender, 2013). What many educators and researchers aligned with the maker movement agree on is the importance of the *process* of making, the possibility to run into challenges and untangle them into personally meaningful projects that

can be shared to enrich a community of makers (Peppler, Halverson, & Kafai, 2016). By sharing projects online, whether puppet shows or programmed animations, makers call for others to comment on their work; represent their processes, challenges, and approaches; and iterate on their work (Tseng, 2015a).

The maker movement is closely aligned with the arts, from which portfolios emerged in the 1990s (Gardner, 1989). Since then, portfolios, and particularly electronic portfolios, have been talked about as promising ways to capture rich learning, improve instruction, and foster learning communities (Lamme & Hysmith, 1991). Through tight coupling between standards and classroom practices, portfolios have been praised as assessment tools that might expand flattened test scores (Love, McKean, & Gathercoal, 2004). Beyond the K-12 education<sup>1</sup>, colleges and professional applications ask youth to share examples of their creative work related to disciplinary practice within or outside schools (Byrne & Davidson, 2015). Making out-of-school practices relevant for future opportunities promises to provide a wider audience with access to higher education and professional opportunities (Peppler, Maltese, Keune, Chang, & Regalla, 2015). Thus, portfolios in out-of-school makerspaces are increasing their relevance. Specifically focused on making, software and hardware tools have been designed for capturing and sharing processes and projects. For example, Spin is a tool that allows youth to create revolving animated GIFs of their projects (Tseng, 2015b). However, it can be challenging for out-of-school makerspaces to implement consistent space-wide portfolio practices. In the flow of making it can feel disruptive to pause and snap a photograph, especially if the photograph does not serve an immediate project purpose (Keune, Peppler, Chang, & Regalla, 2015). It is unclear what immediate purposes would motivate the capturing of making processes.

To better understand youth motivations that could guide portfolio practices in out-of-school makerspaces, we took a sociocultural and situative approach to motivation (Nolen, Horn, & Ward, 2015). Unlike strictly cognitive approaches to motivation that focus on aspects of the learning environment that stimulate internal shifts in individual understanding and skills, situative approaches of motivation are concerned with the meaning of particular social practices within the broader context of a learning environment (Nolen, Horn, & Ward,

2015). For example, rather than considering how photographs of a 3D-printing process communicate an individual's knowledge of the disciplinary concepts of engineering, we focus on the underlying objectives that called the youth to snap and share the pictures in the first place, potentially to explore, engage, and enrich social practices. Apart from understanding what drives youth to document, we are also curious about how technology might mediate and support particular motivations and sustained practice (Blumfeld et al., 1991). We refer to this as mechanisms that facilitate capturing and sharing.

### Introducing the Digital Harbor Foundation

The Digital Harbor Foundation (DHF) is a youth-serving, out-of-school makerspace. The space offers a diverse range of youth programs, including courses centered on 3D printing, constructing micro-controller musical instruments, soldering robotic creatures, and open-ended explorations. The long-standing history of portfolios in the space allowed us to observe how youth documentation takes place, and what motivates and facilitates the youth to create portfolios. The space has been facilitating portfolios since early 2014, and since then has continuously refined its portfolio practices in response to programs and youth needs. Every youth has a WordPress-based portfolio page with a unique URL, and all websites are linked to an umbrella page that displays the latest posts of each portfolio. Overall, the space-wide system presents an opportunity for the youth to document their out-of-school work in an open portfolio that grows with them.

Over the course of a year, our engagement with DHF consisted of online observation of 22 youth portfolios and two field site visits that included observations of youth documentation, and semi-structured portfolio walkthroughs with six youth whom the educators had identified as having exceptional portfolios<sup>2</sup>. The portfolio walkthroughs combined a walkthrough approach from usability testing, in which designers click through their interactive interfaces while performing a typical task (Rieman, Franzke, & Redmiles, 1995), and (2) semi-structured interviews (Merriam & Tisdell, 2015). During the walkthroughs, we asked the youth to open all the online documentation of their projects and to show examples of their work while we asked them questions about their documentation and making practices as well as their motivations

for capturing and sharing their work. Portfolio walkthroughs typically lasted 30 minutes, and were audio- and video recorded.

We chose to dive into three youth portfolio cases in our analysis of motivators and mechanisms because these portfolios extended the adult-initiated process.

## Youth portfolio cases

### *A portfolio for building an extended professional network*

Akida was most intrigued by electronics, coding, and Minecraft. Recently, he had created an interactive project in collaboration with staff and other youth: the makerspace donation box. This project involved the creation of a cube with red and blue laser-cut walls (Image 1). The front side had laser-engraved instructions that read: “Give a donation and get an instant *thank you*.” Below this, Akida’s name and the year of making were engraved. While the box seemed to have been cut and assembled with precision through anchoring the laser-cut pieces tightly together, it was in fact prototypically held together with masking tape. The sides of the boxes had carefully aligned holes similar to those found on speakers, so that sound could escape from the hidden electronics inside the box. Inside, microcontrollers were connected to speakers and programmed to play a recording of makerspace youth



Image 1. Akida's Donation box

and staff members saying “thank you” when someone dropped coins into the box. The donation box was positioned on a small table next to the entrance of the makerspace.

Although the donation box was one of his favorite projects, Akida did not document it on his makerspace portfolio. He planned to share the code for the project in the future, and the fact that the project was displayed and in use at the makerspace made it possible to go back and capture the work online. More importantly, the project was displayed along with other youth projects, including a cardboard sign with embedded LEDs that changed color depending on the hashtags posted to the social media feed of the makerspace. This project inspired the creation of a large light installation for the White House art festival SXSL (South by South Lawn) in 2016. Besides serving as inspiration for potentially larger projects, photographs of the donation box were often shared on social media. For example, sharing a photograph of Akida presenting the donation box at a local manufacturing company made it possible for his work to be amplified and to reach an audience outside the makerspace (see Image 2).

Presenting work to audiences outside the makerspace can be a motivator for youth to preserve their projects. Displaying and using projects inside the makerspace was one mechanism for achieving this, while another was to provide opportunities for anyone to capture and share by encouraging visitors to post pictures for their online network. The interplay of online and offline sharing of youth work in the makerspace and beyond can create dynamic impacts on the way youth experience the possibilities of their projects.

#### *A portfolio for spinning off new projects based on old threads*

Alma was a high school senior at a STEM (science, technology, engineering, and mathematics)-focused school, where she centered her academic interests on engineering. Her school activities differed from those at the makerspace, where she could engage engineering concepts through hands-on creative projects.

The DHF required the youth to create a project combining the many skills and techniques they had learned, including circuitry and 3D printing. Alma created an installation that she titled “Wonderland 2.0” (Image 3). The installation consisted of blue 3D-printed mush-



Image 2. A social media post showing Akida presenting the donation box

rooms that were positioned on a painted cardboard box and connected with copper tape and wires to a Makey Makey breakout board. Using sound-editing software, Alma coordinated eerie sounds to different wires and programmed the computer to play them when the mushrooms were touched.

Incorporating different skills into the project, Alma constructed it one idea at a time, without knowing its final shape or form when she started:

Everything came together. As I first set out in doing this, I would have never expected this to happen. (...) When I first started I began



**Image 3.** Alma's installation "Alice in Wonderland 2.0", combining the skills she learned at the makerspace

with an idea of a mushroom, a table, and a setting created with a 3D printer. Once the sounds and the painting got in, the project grew and ideas started flowing. It was not planned from the start.

In the flow of making, Alma's ideas emerged as she layered more and more skills onto the project while working toward her final project. One example of layering prior skills was related to the stackability of the mushrooms. Similar to a birdhouse she had previously documented on her portfolio (Image 4), Alma had to consider the tolerance setting of the 3D printer she was using to create removable parts. Each of the printers at the makerspace was assembled and calibrated by hand, so it was important to know the settings of the printer in use while working on a project that required precision.

Alma started documenting projects on her DHF website when she joined the makerspace. At designated times, she wrote periodic posts throughout the beginner's course, addressing her audience through witty writing and usually including project photographs. These allotted times presented checkpoints for Alma to remember to keep track of capturing the making in order to better serve the creation of her final project:



Image 4. Screenshot of Alma's bird-house post

I think [my portfolio] helps making. (...) It helps when you're well on your way, you can always go back and remember what you did and what you may not remember in the present. Going back, you can get a fresh look on things, and that changes your perspective and that would also help your current making.

For Alma, consistent documenting was a way to mindfully work toward completing her final project. Jotting down notes online helped her plan ahead. Knowing that the posts would serve to inspire her next moves motivated Alma to document regularly. Prompts and specifically allotted timelines helped her capture her work easily; this portfolio creation became part of her creative flow and facilitated idea spin-offs.

#### *A portfolio for overcoming social apprehension*

Evan joined the makerspace hoping to overcome his shyness and learn to work more easily with others. At the makerspace he could move at

his own pace, from working on personal projects alongside peers, which he called working “human-adjacent,” to contributing to collaborative projects in small groups. In this move to overcome his shyness, Evan’s portfolio played a strong role. Just how important the portfolio was to Evan can be seen in the sheer number of project posts he published online. Over the course of a year he published a total of 33 posts, the highest number in the makerspace. In nine of these posts, he reflected on his social interactions with others. This was nearly triple the average of the other youths, suggesting that Evan was deliberately seeking to capture his progress in this area.

One of the projects Evan highlighted for us as particularly interesting to him was part of a Zombie-centered design course, in which makerspace educators asked the youth to prototype a solution for escaping from zombies across a ravine. Evan created a pulley bridge out of cardboard and string (Image 5, left). He explained that it was challenging to make the bridge function and to plan for a clean, functional design. To show how the bridge would function, Evan shared a video on his portfolio that demoed his prototype (Image 6, right). He explained that he looked across the portfolio entries of other youth working alongside him and noticed that “there were different ways for people to get across the gorge.” The process offered by the online portfolio infrastructure motivated Evan to reflect on face-to-face and online social engagement.

Another example of Evan’s social engagement at the makerspace was related to a Minecraft course, in which small groups of youth collaborated to build a small virtual town. Evan led one of the construction groups, coordinating the actions of his group members with other groups by moving in and out of the virtual space:

When everyone had different pieces of the map, we had to do it twice, because the first time things collapsed. But the second time it worked a lot better when people were forming groups. (...) It was the same when we built the final colony in the final project. Before we worked more organized, we elected leaders and worked in groups. But the first day of building a colony a few people did random stuff and a leader (of another group) got distracted and (the joined) leadership was difficult to keep going. Once everyone decided to build in the same place, the group came together.

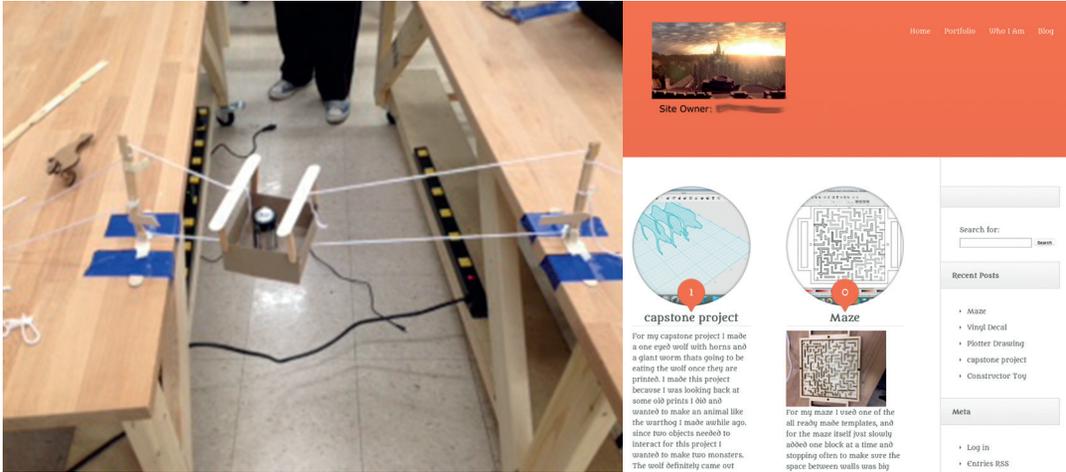


Image 5 & 6. Snapshot of Evan’s pulley bridge (left) and portfolio (right)

Using the portfolio to reflect on social engagements and capture strategies for successfully working with peers seemed to motivate Evan to continue documenting and sharing his work. The mechanism that made this possible was that he could choose how many posts he wanted to share about his engagement, and to follow this own progression through the chronological organization of his posts. Working with these projects and documenting his experiences led Evan to take on new challenges, such as presenting his work outside the makerspace in front of adults he had not previously met. Neither Evan nor the educators had imagined this possibility when he first joined the makerspace.

### Discussion and conclusions

All the cases explored in this article tell unique stories: Akida’s portfolio served to extend his professional network through combining online and offline sharing; Alma’s portfolio helped her spin off new projects based on old threads; and Evan used his portfolio to overcome social apprehension.

Looking across the cases, we identified important motivators and mechanisms in the creation of the three youths’ portfolios that could inform the establishment of portfolio practices in other out-of-school makerspaces. Table 1 summarizes these motivators and mechanisms.

**Table 1.** Motivators and mechanisms of portfolios at the Digital Harbor Foundation

Motivators	Mechanisms
Connecting to authentic audiences	<ul style="list-style-type: none"> <li>• Provide physical and online spaces for sharing projects.</li> <li>• Encourage visitors to capture and share youth projects.</li> </ul>
Taking ownership over portfolios	<ul style="list-style-type: none"> <li>• Offer choice over how and where to document and share.</li> <li>• Make customization features available.</li> <li>• Encourage use of existing tools and support multiple spaces.</li> </ul>
Working toward a final project	<ul style="list-style-type: none"> <li>• Make it known to youth that small projects can build toward final projects.</li> <li>• Allot time for documenting and browsing portfolios.</li> </ul>
Comparing project solutions	<ul style="list-style-type: none"> <li>• Initiate a space-wide portfolio system.</li> <li>• Encourage sharing portfolio posts among youth.</li> </ul>
Encouraging following passions and elaborating interests	<ul style="list-style-type: none"> <li>• Be flexible about number of posts.</li> <li>• Provide opportunities for shifting between personal and shared projects.</li> <li>• Give space to track progress over time.</li> </ul>

The three cases show how possibilities arise as youth are given the space and resources for making and for taking ownership of documenting and sharing their work. This way, portfolios are not simply a requirement set by adults, but a way to share with peers, follow passions, and elaborate interests. Their portfolios allowed these three youth to share their projects on their own terms, in their own ways, and on their own time.

At the DHF, adult-driven portfolio practices ignited and spread documentation throughout the makerspace. All the portfolios presented in this article took the adult-driven portfolio process and turned it into an adult-initiated process that was flexible enough for the youth

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to adapt to their personal purposes and needs. For example, they were motivated by the ability to *follow their passions and elaborate their interests* through a flexible number of required posts, opportunities to shift between personal and collaborative projects, and visual tools for seeing their personal development.

The youth *connected to authentic audiences* who were genuinely interested in their projects presented outside the makerspace, and found their projects being shared on social media by visitors. This speaks to the importance of providing opportunities for youth to engage communities with specialized interests within the safe confines of the out-of-school makerspace. Treated in these ways, portfolios can become tools for uncovering interests and possibilities for future opportunities and community memberships.

The youth were motivated by *taking ownership over their portfolios*, which was encouraged by giving them the power to make choices about aesthetics as well as location(s) in the matter of how and where their work would be viewed by others. The immediate usefulness of the portfolios was also perceived when the youth were allowed to use their portfolios to *work toward a final project*; for example, when the makerspace provided time and space for documenting and browsing portfolios. Viewing projects and portfolios could inspire *comparing project solutions*, new ideas or ways in which challenges could be overcome.

While youth are creating projects in makerspaces, preparing for college or future jobs might be a far-away goal; however, these cases show that the social context of portfolios – creating and sharing work within and outside local learning spaces – may be more immediately useful and personally relevant for youth and serve as a driver to continue documenting. Through diverse tools, the youth took ownership over the process of capturing and sharing their work, and beyond this, took ownership of their future making opportunities and possibilities.

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## Note

1. The expression is a shortening of kindergarten (K) for 4- to 6-year-olds through twelfth grade (12) for 17- to 19-year-olds.
2. More information about the Open Portfolio Project: <http://makered.org/opp/>

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